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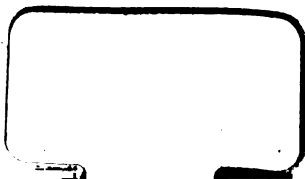
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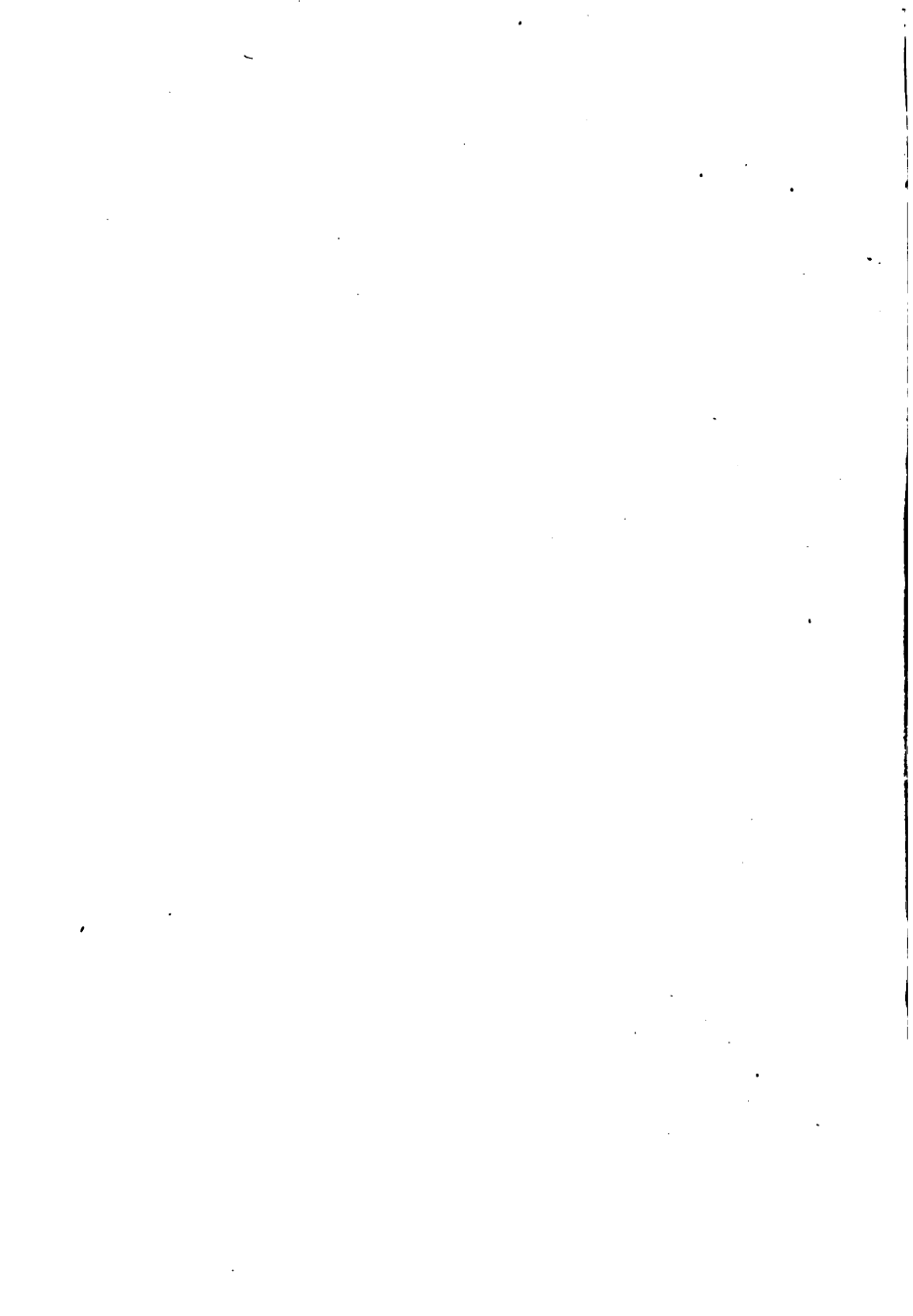
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HAMILTON'S ESSENTIALS OF ARITHMETIC HIGHER GRADES

BY

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PREFACE

THIS series of "Essentials of Arithmetic" consists of three books, which cover the arithmetical work from the second to the eighth year.

The two important ends sought in the teaching of arithmetic are (1) to give the pupil such a mastery of number combinations and processes as will enable him to perform with accuracy and speed all common numerical operations; and (2) to train him in the skillful application of these processes to the problems that he is likely to meet in his daily experiences. This series has aimed to lay equal stress on both these important phases of arithmetic.

The frequent drills in numbers in their abstract relations develop habits of accuracy and speed. Efficiency is encouraged by advising the use of short methods, by frequent timing of the drill work, and by insisting on checks for accuracy.

The problems have been framed with a view to the pupil's interests. Beginning with data drawn from his immediate environment, they reach out gradually to include his contact with the larger spheres of social and industrial life. The problems are of two types,—first, isolated problems, which provide direct application of a principle to some need or experience of the pupil; and, second, groups of related problems, called "Everyday Use of Numbers," which center about an idea or a situation in which the pupil feels a vital interest. These related problems serve as a review of various principles previously taught. The problems are all *real* because they are true to life. They carefully avoid unpractical conditions and all questions that have no relation to

common experience. The business problems follow present business usage.

The pupil's self-activity is utilized in constructive work. His initiative is exercised by leading him to discover many arithmetical truths for himself. The importance of the correct interpretation of problems and of the choice of the best methods for their solution is emphasized. The "Problems Without Numbers" tend to develop the power of generalization.

This book for **Higher Grades** covers the work that is usually taught in the seventh and eighth years, each chapter representing one half year's work.

This work makes wider application of arithmetical principles to the broader fields which the child is likely to enter after leaving school — fields in which problems of taxation, insurance, investments, and other business and social enterprises make a practical demand on arithmetical knowledge. All business applications which are so unusual or so technical that few pupils would ever be required to use them have been omitted.

The effort to follow prevailing prices has been limited by their rapid fluctuations and by their variation in different parts of the country. Teachers should encourage pupils occasionally to substitute current local prices, thereby varying the problems in the book.

SAMUEL HAMILTON

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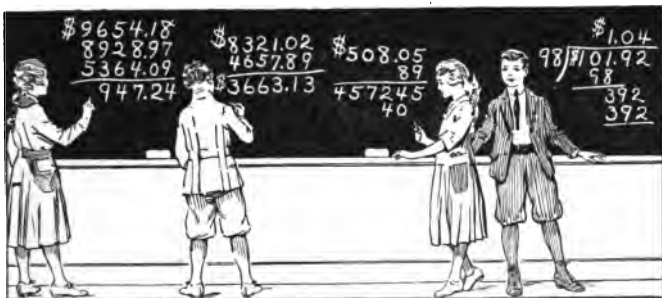
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CHAPTER I

REVIEW

You have now learned how to solve a great variety of problems in arithmetic; but, if you will stop for a moment to consider, you will find that they are all based on one or more of the four processes — addition, subtraction, multiplication, and division. These four processes, as used with integers, with common fractions, and with decimals, are all that you have employed or ever will employ in the solution of any arithmetical problem. It is of great importance, therefore, that you should review these processes again and again until you have acquired habits of speed and accuracy in their use, which you will never lose.

You must also learn the meaning of some important business terms and the nature of certain common business practices. After that, all you have to do is to consider a problem thoughtfully and exercise good judgment in deciding which of the four processes should be applied to meet the given conditions, and you will find yourself able to solve any problem that may confront you in or out of school.

READING AND WRITING NUMBERS

Many mistakes in arithmetic are due to failure to read numbers accurately or to write them carefully.

Read the following statements:

1. Between 1914 and 1918, the farmers in the United States increased the number of acres planted in corn by 4,059,000; barley by 2,114,000; rye by 3,644,000; rice by 418,700; potatoes by 499,000; and hay by 5,357,000.

2. In 1919 the interest on the United States debt amounted to \$1,250,000,000.

You have learned to write numbers to billions. The next period after billions is called **trillions**.

Thus, 105,627,209,007,075 is read "105 trillion, 627 billion, 209 million, 7 thousand, 75."

3. Read: An inch of rainfall on the city of New York amounts to over 5,460,000,000 gallons weighing 22,800,000 tons. The average annual rainfall for the city is 44.6 inches. If this were confined where it fell, there would be almost 244,000,000,000 gallons of water over the city's surface. In a century 24,000,000,000,000 gallons of rain weighing 100,000,000,000 tons fall on this city.

4. Read: The expenditures of the United States in 1918 were \$13,196,071,287.40.

5. Read: Erected to the memory of Theodore Roosevelt in MCMXIX.

6. Write out in full all the numbers in Ex. 1 to 5.

7. Andrew Carnegie donated sixty million three hundred sixty-four thousand dollars to libraries, four million dollars for steel workers' pensions, one hundred fourteen thousand dollars for the blind, and twenty million three hundred sixty thousand dollars to colleges. Write these numbers in columns for adding.

ADDITION AND SUBTRACTION OF INTEGERS AND DECIMALS

Oral Work

Practice on this page until you can get all the correct answers in 4 minutes. (Do not copy the numbers.)

Add:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
8	7	9	6	5	4	3	9	8	8
9	6	5	8	9	9	8	7	5	9
4	5	8	7	7	9	8	7	6	7
—	—	—	—	—	—	—	—	—	—
11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
2	7	3	6	9	3	6	5	4	8
5	8	9	4	5	8	9	9	5	8
6	4	5	6	9	7	8	5	9	9
—	—	—	—	—	—	—	—	—	—
21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
7	3	7	4	8	5	4	3	7	6
0	4	8	6	9	8	9	8	8	7
8	5	9	5	2	0	6	8	9	7
2	6	1	7	1	7	5	4	9	2
—	—	—	—	—	—	—	—	—	—

First add; then subtract:

31.	32.	33.	34.	35.	36.	37.	38.
25	37	87	62	75	64	70	50
6	9	8	9	8	9	5	6
—	—	—	—	—	—	—	—
39.	40.	41.	42.	43.	44.	45.	46.
61	78	57	84	92	85	66	43
3	9	8	8	9	6	7	8
—	—	—	—	—	—	—	—
47.	48.	49.	50.	51.	52.	53.	54.
57	89	58	75	94	97	96	83
28	35	49	56	78	89	58	78
—	—	—	—	—	—	—	—

Written Work

Find how long it takes you to get the correct answers for this page. Then try to improve your record.

Business men sometimes write the sum of each column separately, as in Ex. 1, and then add the separate sums.

Add rapidly :

1.	2.	3.	4.	5.	6.
867	874	948	592	794	440
549	737	706	460	887	345
675	628	635	955	675	990
946	526	570	806	676	886
<u>27</u>	937	442	787	566	750
21	405	313	644	420	687
28	422	264	543	838	740
<u>3037</u>	<u>339</u>	<u>405</u>	<u>488</u>	<u>909</u>	<u>898</u>

7.	8.	9.	10.	11.
\$780.83	\$947.45	\$873.15	\$870.58	\$963.58
695.79	875.29	549.89	735.61	279.25
593.34	796.74	671.37	546.87	748.60
469.95	624.45	724.10	650.33	389.10
354.16	583.03	935.89	468.56	750.47
932.93	408.79	468.38	974.49	290.89
209.10	322.87	529.41	384.95	524.45

12.	13.	14.	15.
897,642	9874.09	87.4643	732.678
198,885	6548.08	6.008	64.1095
203,774	973.05	351.05	328.0502
519,600	651.007	94.0009	79.0057
778,999	429.543	825.027	156.84
<u>566,544</u>	<u>2305.61</u>	<u>69.058</u>	<u>72.0562</u>

Practice subtracting these numbers until you can get all the correct answers in 4 minutes. (Do not copy the numbers.)

- | | | | |
|---|---|---|---|
| 16. $\begin{array}{r} 90,082 \\ 81,036 \\ \hline \end{array}$ | 19. $\begin{array}{r} \$750.24 \\ 488.87 \\ \hline \end{array}$ | 22. $\begin{array}{r} 893,538 \\ 674,999 \\ \hline \end{array}$ | 25. $\begin{array}{r} 840,356 \\ 379,478 \\ \hline \end{array}$ |
| 17. $\begin{array}{r} 78,532 \\ 60,605 \\ \hline \end{array}$ | 20. $\begin{array}{r} \$861.45 \\ 311.16 \\ \hline \end{array}$ | 23. $\begin{array}{r} 781,042 \\ 403,977 \\ \hline \end{array}$ | 26. $\begin{array}{r} 778,643 \\ 406,857 \\ \hline \end{array}$ |
| 18. $\begin{array}{r} 55,443 \\ 49,766 \\ \hline \end{array}$ | 21. $\begin{array}{r} \$681.97 \\ 307.57 \\ \hline \end{array}$ | 24. $\begin{array}{r} 973,010 \\ 258,602 \\ \hline \end{array}$ | 27. $\begin{array}{r} 665,554 \\ 298,795 \\ \hline \end{array}$ |
| 28. $\begin{array}{r} 88,585 \\ 77,398 \\ \hline \end{array}$ | 31. $\begin{array}{r} \$803.81 \\ 425.65 \\ \hline \end{array}$ | 34. $\begin{array}{r} 868,804 \\ 409,395 \\ \hline \end{array}$ | 37. $\begin{array}{r} 5,542,901 \\ 2,264,708 \\ \hline \end{array}$ |
| 29. $\begin{array}{r} 66,943 \\ 44,479 \\ \hline \end{array}$ | 32. $\begin{array}{r} \$999.20 \\ 340.67 \\ \hline \end{array}$ | 35. $\begin{array}{r} 751,052 \\ 647,446 \\ \hline \end{array}$ | 38. $\begin{array}{r} 4,698,372 \\ 1,098,475 \\ \hline \end{array}$ |
| 30. $\begin{array}{r} 55,800 \\ 28,668 \\ \hline \end{array}$ | 33. $\begin{array}{r} \$576.30 \\ 339.40 \\ \hline \end{array}$ | 36. $\begin{array}{r} 433,000 \\ 154,898 \\ \hline \end{array}$ | 39. $\begin{array}{r} 5,087,300 \\ 4,369,579 \\ \hline \end{array}$ |
| 40. $\begin{array}{r} 34.056 \\ 25.999 \\ \hline \end{array}$ | 43. $\begin{array}{r} 95. \\ 6.055 \\ \hline \end{array}$ | 46. $\begin{array}{r} 8715.62 \\ 5439.76 \\ \hline \end{array}$ | 49. $\begin{array}{r} 53,948.75 \\ 32,149.98 \\ \hline \end{array}$ |
| 41. $\begin{array}{r} 8.702 \\ 5.6155 \\ \hline \end{array}$ | 44. $\begin{array}{r} 8.92 \\ 4.5567 \\ \hline \end{array}$ | 47. $\begin{array}{r} 80. \\ 65.3187 \\ \hline \end{array}$ | 50. $\begin{array}{r} 995.5 \\ 941.0956 \\ \hline \end{array}$ |
| 42. $\begin{array}{r} 9.5 \\ .5565 \\ \hline \end{array}$ | 45. $\begin{array}{r} 4.04 \\ 3.9999 \\ \hline \end{array}$ | 48. $\begin{array}{r} 90. \\ 4.2156 \\ \hline \end{array}$ | 51. $\begin{array}{r} 974.06 \\ 879.5628 \\ \hline \end{array}$ |

MULTIPLICATION OF INTEGERS AND DECIMALS

Oral Work

Short Methods. To multiply by 10, 100, 1000, etc., annex to a whole number as many zeros as there are zeros in the multiplier; in a decimal move the decimal point to the right as many places as there are zeros in the multiplier.

To multiply by .1, .01, .001, etc., move the decimal point to the left as many places as there are figures in the multiplier.

To multiply by 9, multiply by 10 and subtract the multiplicand.

To multiply by 11, multiply by 10 and add the multiplicand.

To multiply by 20, 200, 2000, etc., multiply by 2 and add as many zeros to the right of the multiplicand as there are zeros in the multiplier.

To multiply by 19, multiply by 20 and subtract the multiplicand.

To multiply by 21, multiply by 20 and add the multiplicand.

To multiply by 25, multiply by 100 and divide by 4. ($100 \div 4 = 25$.)

To multiply by 99, multiply by 100 and subtract the multiplicand.

To multiply by 125, multiply by 1000 and divide by 8. ($1000 \div 8 = 125$.)

To multiply by $12\frac{1}{2}$, multiply by 100 and divide by 8. ($100 \div 8 = 12\frac{1}{2}$.)

To multiply by $33\frac{1}{3}$, multiply by 100 and divide by 3. ($100 \div 3 = 33\frac{1}{3}$.)

Thus, $10 \times 72 = 720$;	$10 \times .72 = 7.2$	$19 \times 72 = 1440 - 72 = 1368$
$.001 \times 72 = .072$		$99 \times 72 = 7200 - 72 = 7128$
$20 \times 72 = 1440$		$21 \times 72 = 1440 + 72 = 1512$
$25 \times 72 = 7200 \div 4 = 1800$		$125 \times 72 = 72000 \div 8 = 9000$
$11 \times 72 = 720 + 72 = 792$		$12\frac{1}{2} \times 72 = 7200 \div 8 = 900$
$9 \times 72 = 720 - 72 = 648$		$33\frac{1}{3} \times 72 = 7200 \div 3 = 2400$

1. Give a short method of multiplying by 50; by 48; by 99; by 102.

Multiply Ex. 2 to 4 by 10; by 11; by 9; by .001. Multiply Ex. 5 to 7 by 19; by 200; by 25; by 21. Multiply Ex. 8 to 10 by 99; by 102; by 125. Multiply Ex. 11 to 13 by $12\frac{1}{2}$; by $33\frac{1}{3}$:

2. 1520	5. 1996	8. 8000	11. 24,160
3. 1830	6. 4552	9. 7200	12. 48,000
4. 5000	7. 1872	10. 9664	13. 25,200

Written Work

14. Multiply \$1.25 by .025.

$$\begin{array}{r}
 \$1.25 \\
 .025 \\
 \hline
 625 \\
 250 \\
 \hline
 \$.03125
 \end{array}$$

Point off as many decimal places in the product as there are decimal places in both factors. When the number of figures in the product is less than the number of decimal places required, prefix zeros to supply the deficiency.

Find the products :

- | | | |
|--------------------------|---------------------------|---------------------------|
| 15. 89×547 | 22. $.06 \times \$1.50$ | 29. $1.56 \times .98$ |
| 16. 78×689 | 23. $.08 \times \$3.75$ | 30. $3.24 \times .56$ |
| 17. 86×978 | 24. $.06 \times \$48.00$ | 31. $12.5 \times .19$ |
| 18. 609×5408 | 25. $.05 \times \$59.00$ | 32. $.047 \times .621$ |
| 19. $780 \times \$6500$ | 26. $.005 \times \$30.00$ | 33. $.509 \times 25.5$ |
| 20. $870 \times \$50.55$ | 27. $220.5 \times \$9.50$ | 34. $.085 \times 6.24$ |
| 21. $678 \times \$63.80$ | 28. $18.5 \times \$64.50$ | 35. $.378 \times 5.67$ |
| 36. $.18 \times 6.98$ | 43. 39.5×89 | 50. 6.87×2.94 |
| 37. $.9 \times 7.04$ | 44. 46.25×68 | 51. $453 \times .058$ |
| 38. $.15 \times 15.56$ | 45. 341.1×5.45 | 52. $709 \times .675$ |
| 39. $.354 \times .007$ | 46. 56.05×17.5 | 53. 872×20.5 |
| 40. $.467 \times .032$ | 47. $.0564 \times .005$ | 54. $63.5 \times .089$ |
| 41. $.958 \times .019$ | 48. $3.185 \times .094$ | 55. 5.44×7.48 |
| 42. $.004 \times .002$ | 49. $.4005 \times 558$ | 56. $.605 \times 7.09$ |
| 57. $.345 \times .144$ | 64. $.987 \times .017$ | 71. 8.734×1.85 |
| 58. $.064 \times .055$ | 65. $.654 \times 0.55$ | 72. 9.005×22.5 |
| 59. $.678 \times .465$ | 66. $.524 \times .678$ | 73. 105.65×15.75 |
| 60. $.54 \times .875$ | 67. 2.9×1.56 | 74. 55.007×16.45 |
| 61. $5.015 \times .006$ | 68. $.75 \times 3.45$ | 75. 4.115×5.095 |
| 62. $.459 \times 8.66$ | 69. 1.98×1.45 | 76. 5.094×14.05 |
| 63. 20.04×7.54 | 70. 15.7×6.75 | 77. 6.575×13.06 |

DIVISION OF INTEGERS AND DECIMALS

Oral Work

Short Methods. To divide by 10, 100, 1000, etc., move the decimal point as many places to the left as there are zeros in the divisor.

To divide by 5, multiply by 2 and divide by 10. ($\frac{1}{5} = \frac{2}{10}$)

To divide by 25, multiply by 4 and divide by 100. ($\frac{1}{25} = \frac{4}{100}$)

To divide by 125, multiply by 8 and divide by 1000. ($\frac{1}{125} = \frac{8}{1000}$)

To divide by $12\frac{1}{2}$, multiply by 8 and divide by 100.

To divide by $33\frac{1}{3}$, multiply by 3 and divide by 100.

Thus, $25 \div 10 = 2.5$

$25 \div 5 = 5.0 = 5$

$125 \div 25 = 5.00 = 5$

$4000 \div 125 = 32.000 = 32$

$800 \div 12\frac{1}{2} = 64.00 = 64$

$900 \div 33\frac{1}{3} = 27.00 = 27$

1. Give a short method of dividing by 20; by 400; by 50; by $16\frac{2}{3}$.

Divide Ex. 2 to 5 by 10; by 5; by 25; by 125. Divide Ex. 6 to 9 by $12\frac{1}{2}$; by $33\frac{1}{3}$:

2. 375

4. 1500

6. 2400

8. 9600

3. 750

5. 2250

7. 3200

9. 7200

Written Work

10. Divide 1.5175 by .025.

$$\begin{array}{r} 60.7 \\ .025 \overline{)1.5175} \\ \underline{150} ^{\wedge} \\ 175 \\ \underline{175} \end{array}$$

Mark off by a caret the same number of decimal places from the right of the decimal point in the dividend as there are decimal places in the divisor. Place the decimal point in the quotient immediately after all the numbers to the left of the caret have been used in the process of division.

Divide:

11. $115,375 \div 25$

12. $274,176 \div 48$

13. $353,304 \div 56$

14. $121,218 \div 89$

15. $\$59,459.84 \div 824$

16. $\$2222.85 \div 219$

17. $\$87,418.791 \div 621$

18. $\$95,376.824 \div 542$

Divide:

- | | | |
|----------------------------|---------------------------|--------------------------|
| 19. $8 \div 4$ | 28. $32 \div .04$ | 37. $5.74 \div 2.87$ |
| 20. $8 \div .04$ | 29. $3.2 \div .004$ | 38. $5.74 \div .287$ |
| 21. $80 \div .004$ | 30. $320 \div .004$ | 39. $57.4 \div 28.7$ |
| 22. $9 \div .003$ | 31. $75 \div .015$ | 40. $574 \div .287$ |
| 23. $.09 \div 3$ | 32. $75 \div 1.5$ | 41. $792 \div .99$ |
| 24. $90 \div .03$ | 33. $7.5 \div .015$ | 42. $7.92 \div 9.9$ |
| 25. $10 \div .05$ | 34. $60 \div .12$ | 43. $79.2 \div .099$ |
| 26. $10 \div .5$ | 35. $60 \div .012$ | 44. $79.2 \div .99$ |
| 27. $10 \div .005$ | 36. $6 \div .12$ | 45. $79.2 \div 9.9$ |
| 46. $.392 \div 7$ | 55. $15.45 \div .15$ | 64. $123.321 \div 1.11$ |
| 47. $.9 \div .012$ | 56. $2.875 \div .23$ | 65. $351.05 \div 2.006$ |
| 48. $6.63 \div .39$ | 57. $28.35 \div 1.05$ | 66. $1287.81 \div 10.47$ |
| 49. $.1305 \div .145$ | 58. $15.03 \div .167$ | 67. $71.852 \div .0506$ |
| 50. $42 \div 1.2$ | 59. $109.2 \div 2.1$ | 68. $27,660 \div 230.5$ |
| 51. $.189 \div .027$ | 60. $16.4556 \div 36$ | 69. $3.0644 \div .047$ |
| 52. $50.4 \div 1.8$ | 61. $53.028 \div .054$ | 70. $2274.8 \div 6.05$ |
| 53. $15.54 \div .21$ | 62. $125.19 \div 1.95$ | 71. $12.6504 \div 1.004$ |
| 54. $8.769 \div .079$ | 63. $4.62 \div .264$ | 72. $.47124 \div 30.6$ |
| 73. $2175.25 \div 1.75$ | 85. $11.458 \div .0068$ | |
| 74. $50,540.4 \div 45.45$ | 86. $102.6153 \div 101.7$ | |
| 75. $47.232 \div .0768$ | 87. $7469.56 \div 9.065$ | |
| 76. $183.2665 \div 5.021$ | 88. $307.04 \div .0608$ | |
| 77. $756.434 \div .5327$ | 89. $.546875 \div .4375$ | |
| 78. $6895.876 \div 26.26$ | 90. $371.5515 \div .045$ | |
| 79. $530.25 \div 10.5$ | 91. $780.81 \div 76.55$ | |
| 80. $1327.9584 \div 7.004$ | 92. $.330625 \div 5.75$ | |
| 81. $100.98 \div .108$ | 93. $11.7075 \div .0105$ | |
| 82. $503.503 \div .5005$ | 94. $5954.382 \div 6.02$ | |
| 83. $1404.15 \div 12.21$ | 95. $221.3975 \div 1.475$ | |
| 84. $706.293 \div 999$ | 96. $397.3025 \div 25.55$ | |

FACTORS, DIVISORS, AND MULTIPLES

1. What is an integer? a multiple? a factor? an exact divisor? the greatest common divisor (g. c. d.)? the least common multiple (l. c. m.)?

2. Name two factors that produce 28, 36, 35, 64, 96, 81.

3. Name some exact divisors of 24; of 40; of 108; of 132; of 360; of 224.

4. What is the greatest common divisor of 6, 24, and 33? of 8, 12, and 20? of 12, 18, and 30?

A number is divisible by 2 if its ones' figure is 2, 4, 6, 8, or 0.

A number is divisible by 5 if its ones' figure is 5 or 0.

A number is divisible by 3 if the sum of its digits (that is, of the figures) is divisible by 3.

A number is divisible by 9 if the sum of its digits is divisible by 9.

Thus, 549 is divisible by 3 and by 9, since $5 + 4 + 9$, or 18, is divisible by 3 and by 9.

5. Tell by inspection which of the following numbers are divisible by 2; by 3; by 5; by 9:

24, 48, 96, 75, 864, 775, 420, 459, 2457, 6570, 3402.

The least denominator common to several fractions is called the **least common denominator** (l. c. d.) of the fractions. The l. c. d. of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$ is the same as the l. c. m. of 2, 6, and 8, that is, 24.

When you cannot find the l. c. d. by inspection, try multiples of the largest denominator until you find one in which each of the others is exactly contained. Thus, in $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{6}$, try 16, 24. In finding the l. c. d. of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{6}$, the 2 may be ignored, since any multiple of 6 must be a multiple of 2. Similarly, in $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{12}$, the 3 may be ignored; in $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{10}$, the 5 may be ignored, etc. (See also page 315.)

Find the l. c. d. of fractions with the following denominators:

- | | | | |
|-------------|--------------|--------------|--------------|
| 6. 2, 3, 9 | 8. 5, 10, 40 | 10. 3, 6, 36 | 12. 6, 7, 14 |
| 7. 3, 4, 12 | 9. 3, 12, 24 | 11. 3, 2, 6 | 13. 3, 12, 9 |

COMMON FRACTIONS

REDUCTION OF FRACTIONS

Oral and Written Work

Multiplying or dividing both terms of a fraction by the same number does not change its value.

1. Change $\frac{5}{16}$ to 64ths.

$$64 \div 16 = 4$$

$$\frac{5}{16} = \frac{5 \times 4}{16 \times 4} = \frac{20}{64}$$

Since multiplying both terms of a fraction by the same number does not change its value, multiply both terms of the fraction by the quotient of $64 \div 16$, or 4.

2. Change $1\frac{12}{18}$ to lowest terms.

$$\frac{12 \div 3}{18 \div 3} = \frac{4}{6}; \quad \frac{4 \div 2}{6 \div 2} = \frac{2}{3}$$

Or

$$\frac{12 \div 6}{18 \div 6} = \frac{2}{3}$$

Since dividing both terms of a fraction by the same number does not change its value, divide both terms by 3 and both terms of the resulting fraction by 2, leaving the factors 2 and 3. Hence $1\frac{12}{18} = 1\frac{2}{3}$.

Or, divide both terms of the fraction directly by the greatest common divisor, 6.

3. Change $18\frac{15}{18}$ to an improper fraction.

$$\text{SOLUTION. } 18 = 18\frac{18}{18}; \quad 18\frac{18}{18} + 1\frac{15}{18} = 19\frac{33}{18} \wedge$$

4. Change $14\frac{7}{8}$ to a mixed number.

$$\frac{147}{8} = 147 \div 8 = 18\frac{3}{8}$$

Since a fraction is an indicated division, $14\frac{7}{8} = 147 \div 8 = 18\frac{3}{8}$.

5. Change $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{5}{6}$ to similar fractions having the least common denominator.

$$\text{SOLUTION. l. c. d.} = 18.$$

$$\frac{1}{2} = \frac{9}{18}; \quad \frac{2}{3} = \frac{12}{18}; \quad \frac{5}{6} = \frac{15}{18}.$$

Change:

6. $\frac{1}{8}$ to 12ths

9. $\frac{3}{10}$ to 20ths

12. $\frac{2}{5}$ to 15ths

7. $\frac{3}{4}$ to 16ths

10. $\frac{2}{3}$ to 9ths

13. $\frac{7}{9}$ to 18ths

8. $\frac{5}{6}$ to 12ths

11. $\frac{2}{5}$ to 10ths

14. $\frac{3}{8}$ to 16ths

Change to lowest terms :

15. $\frac{15}{25}$	19. $\frac{54}{72}$	23. $\frac{36}{42}$	27. $\frac{36}{81}$	31. $\frac{125}{175}$
16. $\frac{25}{55}$	20. $\frac{18}{28}$	24. $\frac{63}{72}$	28. $\frac{128}{176}$	32. $\frac{128}{360}$
17. $\frac{42}{48}$	21. $\frac{42}{48}$	25. $\frac{35}{75}$	29. $\frac{24}{144}$	33. $\frac{90}{360}$
18. $\frac{72}{81}$	22. $\frac{21}{36}$	26. $\frac{27}{72}$	30. $\frac{84}{96}$	34. $\frac{40}{360}$

Change to improper fractions :

35. $12\frac{2}{3}$	38. $75\frac{5}{12}$	41. $268\frac{27}{100}$	44. $391\frac{5}{36}$
36. $15\frac{5}{8}$	39. $95\frac{21}{25}$	42. $324\frac{15}{16}$	45. $16\frac{11}{60}$
37. $22\frac{7}{8}$	40. $103\frac{11}{20}$	43. $502\frac{23}{25}$	46. $901\frac{5}{32}$

Change to integers or mixed numbers :

47. $\frac{31}{15}$	50. $\frac{715}{32}$	53. $\frac{216}{20}$	56. $\frac{2368}{15}$
48. $5\frac{27}{8}$	51. $\frac{154}{50}$	54. $\frac{329}{36}$	57. $\frac{1760}{36}$
49. $\frac{256}{7}$	52. $\frac{111}{12}$	55. $\frac{576}{24}$	58. $\frac{5280}{100}$

Change to least similar fractions :

59. $\frac{1}{3}, \frac{1}{4}, \frac{5}{12}$	61. $\frac{1}{5}, \frac{3}{10}, \frac{7}{40}$	63. $\frac{2}{3}, \frac{1}{6}, \frac{5}{36}$	65. $\frac{5}{6}, \frac{3}{7}, \frac{9}{14}$
60. $\frac{2}{3}, \frac{1}{5}, \frac{2}{15}$	62. $\frac{1}{3}, \frac{5}{12}, \frac{7}{24}$	64. $\frac{1}{3}, \frac{1}{2}, \frac{1}{6}$	66. $\frac{1}{3}, \frac{5}{12}, \frac{2}{9}$

ADDITION AND SUBTRACTION OF FRACTIONS

Oral and Written Work

1. Find the sum of $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{8}{9}$.

l. c. d., 36

$$\begin{array}{r} 2 = \frac{24}{36} \\ 3 = \frac{27}{36} \\ 4 = \frac{27}{36} \\ 8 = \frac{32}{36} \\ 9 = \frac{32}{36} \\ \hline 28 = 2\frac{11}{36} \end{array}$$

The least common denominator is 36. Change the given fractions to 36ths. $\frac{2}{3} = \frac{24}{36}$; $\frac{3}{4} = \frac{27}{36}$; $\frac{8}{9} = \frac{32}{36}$.

The sum of these fractions = $\frac{84}{36}$, or $2\frac{11}{36}$.

2. Find the difference between $\frac{8}{9}$ and $\frac{3}{4}$.

SOLUTION. Reduce $\frac{8}{9}$ and $\frac{3}{4}$ to 36ths, as above. Then $\frac{32}{36} - \frac{27}{36} = \frac{5}{36}$.

Add or subtract, as indicated:

- | | | | |
|---|--|--|------------------------------------|
| 3. $\frac{1}{2} + \frac{3}{4}$ | 13. $\frac{5}{12} - \frac{3}{10}$ | 23. $\frac{3}{4} + \frac{11}{12}$ | 33. $\frac{2}{3} + \frac{7}{12}$ |
| 4. $\frac{7}{12} - \frac{1}{3}$ | 14. $\frac{5}{6} - \frac{1}{7}$ | 24. $\frac{2}{3} - \frac{2}{9}$ | 34. $\frac{3}{8} - \frac{5}{16}$ |
| 5. $\frac{4}{15} + \frac{1}{5}$ | 15. $\frac{3}{4} + \frac{5}{9}$ | 25. $\frac{5}{8} - \frac{9}{16}$ | 35. $\frac{2}{3} - \frac{4}{9}$ |
| 6. $\frac{3}{4} - \frac{1}{12}$ | 16. $\frac{3}{10} + \frac{5}{6}$ | 26. $\frac{2}{3} - \frac{3}{10}$ | 36. $\frac{3}{5} - \frac{3}{10}$ |
| 7. $\frac{11}{12} - \frac{2}{3}$ | 17. $\frac{4}{5} - \frac{7}{15}$ | 27. $\frac{5}{8} + \frac{5}{16}$ | 37. $\frac{2}{3} + \frac{8}{9}$ |
| 8. $\frac{5}{9} + \frac{2}{3}$ | 18. $\frac{5}{6} - \frac{5}{12}$ | 28. $\frac{3}{10} - \frac{3}{20}$ | 38. $\frac{5}{12} + \frac{4}{5}$ |
| 9. $\frac{1}{8} + \frac{5}{6}$ | 19. $\frac{2}{3} + \frac{3}{4}$ | 29. $\frac{2}{7} - \frac{2}{14}$ | 39. $\frac{5}{16} + \frac{7}{12}$ |
| 10. $\frac{3}{5} - \frac{3}{8}$ | 20. $\frac{3}{8} + \frac{9}{16}$ | 30. $\frac{2}{9} - \frac{2}{18}$ | 40. $\frac{5}{8} - \frac{3}{20}$ |
| 11. $\frac{5}{14} + \frac{3}{7}$ | 21. $\frac{7}{9} + \frac{11}{18}$ | 31. $\frac{3}{4} + \frac{4}{5}$ | 41. $\frac{2}{3} + \frac{5}{6}$ |
| 12. $\frac{3}{16} + \frac{1}{2}$ | 22. $\frac{1}{2} + \frac{2}{9}$ | 32. $\frac{4}{5} - \frac{8}{10}$ | 42. $\frac{11}{16} - \frac{5}{12}$ |
| 43. $\frac{5}{8} + \frac{3}{4} - \frac{3}{8}$ | 47. $\frac{5}{16} - \frac{1}{4} + \frac{7}{8}$ | 51. $2\frac{1}{4} - 1\frac{7}{8} + 5\frac{3}{16}$ | |
| 44. $\frac{3}{4} - \frac{5}{16} + \frac{5}{8}$ | 48. $2\frac{5}{7} + \frac{1}{2} - \frac{11}{14}$ | 52. $3\frac{5}{7} - 2\frac{1}{4} + 1\frac{1}{2}$ | |
| 45. $7\frac{1}{4} - 3\frac{2}{3} + \frac{3}{8}$ | 49. $3\frac{1}{3} - \frac{5}{6} + 3\frac{5}{8}$ | 53. $1\frac{7}{9} + 2\frac{2}{3} - 1\frac{7}{18}$ | |
| 46. $\frac{2}{8} - \frac{1}{5} + 1\frac{3}{10}$ | 50. $6\frac{1}{12} - 3\frac{7}{10} + 1\frac{3}{8}$ | 54. $3\frac{1}{4} + 2\frac{1}{3} - 3\frac{11}{12}$ | |

First add; then subtract:

- | | | | |
|---|--|---|--|
| 55. $\begin{array}{r} 5\frac{3}{4} \\ 2\frac{1}{2} \\ \hline \end{array}$ | 60. $\begin{array}{r} 14\frac{5}{18} \\ 8\frac{3}{9} \\ \hline \end{array}$ | 65. $\begin{array}{r} 6\frac{3}{10} \\ 3\frac{3}{5} \\ \hline \end{array}$ | 70. $\begin{array}{r} 4\frac{2}{3} \\ 1\frac{3}{10} \\ \hline \end{array}$ |
| 56. $\begin{array}{r} 31\frac{5}{16} \\ 3\frac{5}{8} \\ \hline \end{array}$ | 61. $\begin{array}{r} 18\frac{5}{8} \\ 8\frac{3}{4} \\ \hline \end{array}$ | 66. $\begin{array}{r} 4\frac{5}{6} \\ 3\frac{2}{3} \\ \hline \end{array}$ | 71. $\begin{array}{r} 12\frac{7}{8} \\ 7\frac{5}{16} \\ \hline \end{array}$ |
| 57. $\begin{array}{r} 54\frac{11}{12} \\ 46\frac{5}{6} \\ \hline \end{array}$ | 62. $\begin{array}{r} 4\frac{7}{10} \\ 2\frac{4}{5} \\ \hline \end{array}$ | 67. $\begin{array}{r} 56\frac{3}{4} \\ 49\frac{7}{8} \\ \hline \end{array}$ | 72. $\begin{array}{r} 47\frac{2}{3} \\ 28\frac{1}{3} \\ \hline \end{array}$ |
| 58. $\begin{array}{r} 13\frac{2}{3} \\ 7\frac{2}{3} \\ \hline \end{array}$ | 63. $\begin{array}{r} 15\frac{5}{7} \\ 2\frac{1}{2} \\ \hline \end{array}$ | 68. $\begin{array}{r} 33\frac{1}{6} \\ 21\frac{1}{4} \\ \hline \end{array}$ | 73. $\begin{array}{r} 15\frac{3}{4} \\ 2\frac{7}{16} \\ \hline \end{array}$ |
| 59. $\begin{array}{r} 7\frac{7}{12} \\ 4\frac{2}{3} \\ \hline \end{array}$ | 64. $\begin{array}{r} 14\frac{3}{4} \\ 10\frac{5}{12} \\ \hline \end{array}$ | 69. $\begin{array}{r} 41\frac{11}{20} \\ 2\frac{3}{10} \\ \hline \end{array}$ | 74. $\begin{array}{r} 16\frac{2}{5} \\ 12\frac{3}{10} \\ \hline \end{array}$ |

MULTIPLICATION OF FRACTIONS

Oral and Written Work

1. Find
- $\frac{5}{8} \times \frac{16}{25}$
- .

$$\frac{5}{8} \times \frac{16}{25} = \frac{5 \times 16}{8 \times 25} = \frac{80}{200}, \text{ or } \frac{2}{5}$$

Or

$$\begin{array}{r} 2 \\ \cancel{8} \times \frac{\cancel{16}^2}{\cancel{25}_5} = \frac{2}{5} \end{array}$$

In the first model, the product of the numerators = 80; of the denominators, 200; $\frac{80}{200} = \frac{2}{5}$.

The second model shows how the work may be shortened by cancellation.

Multiply the numerators for the numerator of the product and the denominators for the denominator of the product, canceling when possible.

NOTE. Finding a fractional part of a number is the same as multiplying the number by the fraction. Thus, $\frac{1}{2}$ of 8 = $\frac{1}{2} \times 8$; $\frac{1}{3}$ of $\frac{2}{3}$ = $\frac{1}{3} \times \frac{2}{3}$.

2. Find
- $\frac{3}{8}$
- of
- $2\frac{1}{2}$
- .

SOLUTION. $2\frac{1}{2} = \frac{5}{2}$; $\frac{3}{8}$ of $\frac{5}{2} = \frac{15}{16}$.

3. Multiply
- 16
- by
- $3\frac{3}{8}$
- .

$$\begin{array}{r} 16 \\ \quad 3\frac{3}{8} \\ \hline \frac{3}{8} \times 16 = 6 \\ 3 \times 16 = 48 \\ 3\frac{3}{8} \times 16 = 54 \end{array}$$

4. Multiply
- $15\frac{5}{8}$
- by
- 7
- .

$$\begin{array}{r} 15\frac{5}{8} \\ \quad 7 \\ \hline 7 \times \frac{5}{8} = \frac{35}{8} \\ 7 \times 15 = 105 \\ 7 \times 15\frac{5}{8} = 109\frac{3}{8} \end{array}$$

5. Multiply
- $3\frac{1}{2}$
- by
- $2\frac{1}{3}$
- .

SOLUTION. $3\frac{1}{2} = \frac{7}{2}$; $2\frac{1}{3} = \frac{5}{3}$; $\frac{7}{2} \times \frac{5}{3} = \frac{35}{6} = 5\frac{5}{6}$.

Find the products :

6. $24 \times \frac{7}{8}$

8. $33 \times 2\frac{3}{8}$

10. $2\frac{1}{15} \times 35$

7. $33 \times \frac{2}{3}$

9. $\frac{1}{12}$ of 24

11. $\frac{3}{8} \times \frac{2}{5}$

Find the products:

- | | | |
|--|---|--|
| 12. $\frac{5}{16} \times \frac{5}{8}$ | 23. $\frac{31}{860}$ of $\frac{3}{100}$ | 34. $\frac{5}{8}$ of $12\frac{3}{4}$ |
| 13. $\frac{13}{20} \times \frac{4}{25}$ | 24. $\frac{21}{865}$ of $\frac{5}{7}$ | 35. $\frac{7}{12}$ of $10\frac{4}{5}$ |
| 14. $\frac{9}{50} \times \frac{2}{3}$ | 25. $\frac{24}{25}$ of $\frac{15}{16}$ | 36. $\frac{3}{4} \times 2\frac{1}{5}$ |
| 15. $\frac{25}{36} \times \frac{2}{15}$ | 26. $\frac{11}{27} \times 108$ | 37. $\frac{2}{5} \times 5\frac{1}{2}$ |
| 16. $\frac{19}{60} \times \frac{7}{12}$ | 27. $\frac{3}{20} \times 50$ | 38. $\frac{3}{8} \times 3\frac{1}{2}$ |
| 17. $\frac{5}{18} \times \frac{13}{60}$ | 28. $3\frac{1}{2} \times 125$ | 39. $2\frac{1}{2} \times 3\frac{3}{4}$ |
| 18. $\frac{7}{30}$ of $\frac{3}{100}$ | 29. $\frac{8}{15} \times 135$ | 40. $48\frac{3}{5} \times 612$ |
| 19. $\frac{3}{25} \times \frac{5}{9}$ | 30. $\frac{7}{88} \times 24$ | 41. $842 \times 95\frac{7}{8}$ |
| 20. $\frac{13}{144} \times \frac{7}{12}$ | 31. $12\frac{2}{7} \times 28$ | 42. $34\frac{3}{10} \times 728$ |
| 21. $\frac{9}{11} \times \frac{11}{36}$ | 32. $45 \times 11\frac{7}{8}$ | 43. $96 \times 207\frac{3}{8}$ |
| 22. $\frac{37}{32} \times \frac{4}{9}$ | 33. $60 \times 85\frac{3}{8}$ | 44. $596 \times 56\frac{3}{4}$ |

DIVISION OF FRACTIONS

Oral and Written Work

1. Divide 8 by
- $\frac{2}{3}$
- .

Invert the divisor $\frac{2}{3}$ to $\frac{3}{2}$ and multiply, using cancellation.

$$8 \div \frac{2}{3} = 8 \times \frac{3}{2} = 12$$

2. Divide
- $\frac{5}{16}$
- by 4.

Invert the divisor 4 to $\frac{1}{4}$ and multiply.

$$\frac{5}{16} \div 4 = \frac{5}{16} \times \frac{1}{4} = \frac{5}{64}$$

3. Divide
- $\frac{5}{16}$
- by
- $\frac{3}{4}$
- .

Invert the divisor $\frac{3}{4}$ to $\frac{4}{3}$ and multiply, using cancellation.

$$\frac{5}{16} \div \frac{3}{4} = \frac{5}{16} \times \frac{4}{3} = \frac{5}{12}$$

4. Divide
- $3\frac{1}{8}$
- by 5.

5. Divide 5 by
- $3\frac{1}{8}$
- .

$$3\frac{1}{8} = \frac{25}{8}; \quad \frac{25}{8} \div 5 = \frac{25}{8} \times \frac{1}{5} = \frac{5}{8}$$

$$5 \div 3\frac{1}{8} = 5 \times \frac{8}{25} = \frac{8}{5} = 1\frac{3}{5}$$

Invert the terms of the divisor and multiply, canceling when possible.

6. Divide $1286\frac{7}{8}$ by 9.

$$\begin{array}{r} 9 \overline{)1286\frac{7}{8}} \\ 142\frac{71}{72} \end{array}$$

When the mixed number is a large number, proceed as in the model, changing the remaining mixed number, $8\frac{7}{8}$, to the improper fraction, $\frac{71}{8}$, and dividing it by 9. Thus, $\frac{1}{9}$ of $\frac{71}{8} = \frac{71}{72}$.

Divide:

7. $4 \div \frac{2}{3}$

8. $10 \div \frac{5}{8}$

9. $\frac{3}{4} \div 5$

10. $\frac{7}{8} \div 9$

11. $18 \div \frac{3}{10}$

12. $16 \div \frac{2}{3}$

13. $\frac{10}{20} \div 15$

28. $2\frac{4}{7} \div 6$

29. $4\frac{1}{5} \div 7$

30. $4\frac{8}{11} \div 13$

31. $2\frac{2}{5} \div 36$

32. $5\frac{1}{2} \div 23$

14. $\frac{3}{4} \div \frac{2}{3}$

15. $\frac{2}{3} \div \frac{3}{8}$

16. $\frac{7}{8} \div \frac{3}{4}$

17. $\frac{9}{10} \div \frac{3}{5}$

18. $\frac{1}{6} \div \frac{5}{8}$

19. $\frac{9}{16} \div \frac{3}{8}$

20. $\frac{7}{12} \div \frac{2}{3}$

33. $16 \div 2\frac{2}{3}$

34. $30 \div 3\frac{1}{4}$

35. $22 \div 5\frac{1}{2}$

36. $17 \div 3\frac{2}{5}$

37. $26 \div 2\frac{1}{8}$

21. $\frac{9}{10} \div \frac{3}{8}$

22. $\frac{4}{5} \div \frac{8}{9}$

23. $\frac{1}{25} \div \frac{3}{9}$

24. $\frac{11}{12} \div \frac{11}{12}$

25. $\frac{2}{5} \div \frac{4}{5}$

26. $\frac{9}{20} \div \frac{9}{10}$

27. $\frac{5}{6} \div \frac{25}{8}$

38. $2\frac{1}{2} \div 3\frac{3}{4}$

39. $3\frac{1}{3} \div 1\frac{1}{4}$

40. $5\frac{2}{5} \div 1\frac{4}{5}$

41. $1\frac{3}{8} \div 2\frac{3}{8}$

42. $2\frac{3}{5} \div 2\frac{1}{2}$

43. $25681\frac{1}{2} \div 8$

44. $9868\frac{7}{16} \div 6$

45. $6582\frac{1}{2} \div 8$

46. $6879\frac{9}{10} \div 5$

47. $36370\frac{5}{8} \div 11$

48. $8002\frac{7}{12} \div 16$

49. $4428\frac{1}{16} \div 12$

50. $10935\frac{3}{5} \div 4$

51. $9720\frac{3}{8} \div 11$

52. $7090\frac{9}{10} \div 9$

A fraction that has a fraction or a mixed number in either or both of its terms is called a **complex fraction**. A complex fraction is simply an indicated division of fractions.

$$5\frac{1}{2} \div 2\frac{1}{4} = \frac{11}{2} \div \frac{5}{4} = \frac{11}{2} \times \frac{4}{5} = 2.$$

Find the value of:

53. $\frac{\frac{2}{3}}{\frac{3}{4}}$

54. $\frac{\frac{3}{4}}{\frac{5}{6}}$

55. $\frac{3\frac{3}{4}}{\frac{8}{3}}$

56. $\frac{2\frac{3}{4}}{1\frac{1}{8}}$

FRACTIONAL RELATIONS

1. What part of 114 is 95?

SOLUTION. $95 = \frac{95}{114}$, or $\frac{5}{6}$, of 114.

2. What part of $5\frac{1}{4}$ is $\frac{3}{8}$?

SOLUTION. $5\frac{1}{4} = \frac{21}{4}$; $\frac{\frac{3}{8}}{\frac{21}{4}} = \frac{3}{8} \div \frac{21}{4} = \frac{3}{8} \times \frac{4}{21} = \frac{1}{14}$.

What part of:

3. 60 is 45? 5. 56 is 21? 7. $\frac{5}{8}$ is $\frac{4}{5}$? 9. 8 is $1\frac{1}{4}$?

4. 72 is 28? 6. 126 is 18? 8. $\frac{7}{8}$ is $\frac{5}{12}$? 10. $3\frac{1}{2}$ is $2\frac{1}{4}$?

11. If $\frac{5}{8}$ of a number is 60, what is the number?

SOLUTION. $\frac{5}{8} \times$ the required number = 60. Hence $60 =$ the product of $\frac{5}{8}$ by the required number. Therefore the number = $60 \div \frac{5}{8}$, or 72.

12. 480 is $\frac{4}{5}$ of what number?

SUGGESTION. $480 = \frac{4}{5} \times$ the number. $480 \div \frac{4}{5} = ?$

13. If $\frac{7}{10}$ is $\frac{3}{8}$ of a number, what is the number?

SUGGESTION. $\frac{7}{10} = \frac{3}{8} \times$ the number. $\frac{7}{10} \div \frac{3}{8} = ?$

Find the number of which:

14. 50 is $\frac{5}{6}$ 16. $2\frac{1}{2}$ is $\frac{5}{6}$ 18. $\frac{3}{4}$ is $\frac{7}{8}$ 20. $5\frac{5}{8}$ is $\frac{5}{32}$

15. 84 is $\frac{7}{10}$ 17. $3\frac{3}{4}$ is $\frac{15}{16}$ 19. $\frac{5}{6}$ is $\frac{5}{18}$ 21. $3\frac{2}{3}$ is $1\frac{1}{2}$

PARTS OF ONE DOLLAR

Review the following table of parts of \$1:

$$$.06\frac{1}{4} = \frac{1}{16} \text{ of } \$1. \quad $.25 = \frac{1}{4} \text{ of } \$1. \quad $.66\frac{2}{3} = \frac{2}{3} \text{ of } \$1.$$

$$$.08\frac{1}{3} = \frac{1}{12} \text{ of } \$1. \quad $.33\frac{1}{3} = \frac{1}{3} \text{ of } \$1. \quad $.75 = \frac{3}{4} \text{ of } \$1.$$

$$$.12\frac{1}{2} = \frac{1}{8} \text{ of } \$1. \quad $.37\frac{1}{2} = \frac{3}{8} \text{ of } \$1. \quad $.83\frac{1}{3} = \frac{5}{6} \text{ of } \$1.$$

$$$.16\frac{2}{3} = \frac{1}{6} \text{ of } \$1. \quad $.62\frac{1}{2} = \frac{5}{8} \text{ of } \$1. \quad $.87\frac{1}{2} = \frac{7}{8} \text{ of } \$1.$$

Find the cost of :

- | | | |
|---------------------------------|---------------------------------|---------------------------------|
| 1. 18 lb. @ \$.16 $\frac{1}{2}$ | 4. 24 yd. @ \$.12 $\frac{1}{2}$ | 7. 64 lb. @ \$.06 $\frac{1}{4}$ |
| 2. 27 yd. @ \$.33 $\frac{1}{3}$ | 5. 60 lb. @ \$.08 $\frac{1}{3}$ | 8. 40 yd. @ \$.37 $\frac{1}{2}$ |
| 3. 32 lb. @ \$.62 $\frac{1}{2}$ | 6. 72 yd. @ \$.83 $\frac{1}{3}$ | 9. 56 yd. @ \$.87 $\frac{1}{2}$ |

How many yards can be bought for :

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| 10. \$10 @ \$.62 $\frac{1}{2}$ | 13. \$15 @ \$.12 $\frac{1}{2}$ | 16. \$32 @ \$.06 $\frac{1}{4}$ |
| 11. \$12 @ \$.33 $\frac{1}{3}$ | 14. \$36 @ \$.08 $\frac{1}{3}$ | 17. \$30 @ \$.37 $\frac{1}{2}$ |
| 12. \$14 @ \$.87 $\frac{1}{2}$ | 15. \$70 @ \$.83 $\frac{1}{3}$ | 18. \$60 @ \$.66 $\frac{2}{3}$ |

COMMON FRACTIONS AND DECIMALS

1. Change .37 $\frac{1}{2}$ to a common fraction in its lowest terms

SOLUTION. $.37\frac{1}{2} = .375 = \frac{375}{1000} = \frac{3}{8}$.

2. Change .83 $\frac{1}{3}$ to a common fraction in its lowest terms

SOLUTION. $.83\frac{1}{3} = 2\frac{1}{3} \div 100 = \frac{201}{100} = \frac{1}{50}$.

Change to fractions in their lowest terms:

- | | | | | |
|--------|----------|----------|-----------------------|-----------|
| 3. .48 | 7. .035 | 11. .055 | 15. .66 $\frac{2}{3}$ | 19. .0625 |
| 4. .56 | 8. .072 | 12. .375 | 16. .33 $\frac{1}{3}$ | 20. .0875 |
| 5. .72 | 9. .044 | 13. .875 | 17. .16 $\frac{2}{3}$ | 21. .0375 |
| 6. .44 | 10. .065 | 14. .625 | 18. .08 $\frac{1}{3}$ | 22. .0125 |

23. Change $\frac{3}{5}$ to a decimal; $\frac{4}{7}$ to a decimal.

SOLUTION. $\frac{3}{5} = 3 \div 5 = .6$. $\frac{4}{7} = 4 \div 7 = .571\frac{1}{7}$, or $.571\frac{1}{7}$.

Change to decimals of not more than four places:

- | | | | | |
|-------------------|--------------------|---------------------|----------------------|---------------------|
| 24. $\frac{3}{8}$ | 29. $\frac{5}{12}$ | 34. $\frac{4}{11}$ | 39. $\frac{7}{16}$ | 44. $\frac{7}{200}$ |
| 25. $\frac{5}{8}$ | 30. $\frac{5}{16}$ | 35. $\frac{3}{14}$ | 40. $\frac{7}{32}$ | 45. $\frac{17}{20}$ |
| 26. $\frac{7}{8}$ | 31. $\frac{7}{20}$ | 36. $\frac{2}{75}$ | 41. $\frac{3}{40}$ | 46. $\frac{12}{25}$ |
| 27. $\frac{2}{3}$ | 32. $\frac{7}{9}$ | 37. $\frac{5}{36}$ | 42. $\frac{11}{200}$ | 47. $\frac{7}{30}$ |
| 28. $\frac{5}{6}$ | 33. $\frac{6}{7}$ | 38. $\frac{5}{144}$ | 43. $\frac{2}{200}$ | 48. $\frac{21}{25}$ |

HOW TO SOLVE PROBLEMS

I. Before you try to solve a problem you must find out exactly what it means. That is, you must consider :

- a. What facts are stated or implied in the problem.
- b. What kind of answer the question asks for.
- c. By what steps the required answer can be found from the given facts.

II. The most important habit to acquire is **accuracy**. A wrong answer is worthless. Always test your work. Also make a **mental estimate** of the answer.

III. The second essential is **rapidity**. To secure rapidity, always choose the *shortest method* of work where several methods are possible. It is sometimes well to *indicate* the necessary operations before performing any of them. Then the work may often be shortened by *cancellation*.

1. Find the cost of $3\frac{3}{4}$ lb. of lamb at \$.39 a pound.

Facts stated: Amount of lamb bought; price per pound.

Question: What is the cost of the total amount bought?

Mental estimate: $3\frac{3}{4}$ lb. @ \$.39 cost about $3\frac{1}{2} \times \$.40$, or \$1.50.

Written work: $3\frac{3}{4} = 1\frac{1}{2} + 2$; $1\frac{1}{2} \times \$.39 = \$.585$.

Test: $3 \times \$.39 = \1.17 ; $\frac{3}{4}$ of \$.39 = \$.30; $\$1.17 + \$.30 = \$1.47$.

Tell by mental estimates which is greater :

2. $99 \times \$5$ or $100 \times \$4$; $\frac{7}{8}$ of $5\frac{1}{2}$ or 6; $1\frac{1}{8} \times 6$ or 7.

3. How much cheaper is it to buy 3 dozen plums at 15¢ a dozen than at 3 for 5¢?

4. How much is saved by buying $3\frac{1}{2}$ lb. of sugar for 35¢ instead of at $10\frac{1}{2}$ ¢ a pound?

In business, the seller usually regards any part of a cent as an additional cent. In computations in percentage and interest, however, less than one half cent in the final result is discarded and one half cent or a greater fraction of a cent is counted as an extra cent.

5. Mr. Mason earned \$66 in a 44-hour week. What were his wages per hour?

6. Mr. Clarke earned \$48 in 6 days. How much, at the same rate, did he earn in 15 days?

7. Mrs. Best bought a phonograph for \$75. She paid \$15 down and the rest at \$2.50 a week. How many weeks did it take her to pay the bill in full?

8. When a dozen peaches cost 30¢ how much did 5 peaches cost?

9. When a dozen lemons cost 18¢ how many lemons could be bought for 30¢?

10. When $\frac{1}{4}$ doz. oranges cost 10¢, how much did $1\frac{1}{2}$ dozen cost?

11. When the wholesale price of lima beans was $11\frac{3}{4}$ ¢ a pound and the retail price was $16\frac{1}{2}$ ¢ a pound, what profit did a wholesaler make on a sale of 500 lb.?

12. If a $24\frac{1}{2}$ -pound bag of flour cost \$1.47, how much did $3\frac{1}{2}$ lb. cost at the same rate?

13. Mrs. Fox bought at the grocery store 9 lb. of corn-meal @ \$.06 $\frac{1}{4}$, 5 lb. of potatoes @ \$.03 $\frac{1}{2}$, and 2 cans of tomatoes @ \$.15 $\frac{1}{2}$. How much change did she get from \$2?

14. At the butcher's she bought $3\frac{1}{2}$ lb. of beef for stew @ \$.29, $4\frac{1}{4}$ lb. leg of lamb @ \$.38, and $3\frac{1}{4}$ lb. pork chops @ \$.46. How much change did she get from \$5?

15. A man with an income of \$4500 a year spent .33 of it for food, .24 for rent, and .13 for clothing. How much did each of these items amount to? What part of his total income did he spend for them?

16. A family with an income of \$1500 a year spent \$450 for food, \$200 for clothing, and \$250 for rent. What part of the income was paid for each of these items?

17. This table shows the fighting ships of the various nations in September, 1919:

NATION	NUMBER OF SHIPS	TONNAGE	NATION	NUMBER OF SHIPS	TONNAGE
England . . .	702	2,415,962	Germany . . .	276	561,669
United States .	244	931,803	Russia	156	376,522
Japan	136	599,801	Italy	228	287,065
France	239	580,668			

Find (a) the total number of ships included in this table; (b) the total tonnage; (c) the average tonnage for each ship in each country to hundredths; (d) the amount that England exceeds the United States in tonnage; (e) the amount of excess of the United States over Japan; (f) of Japan over France; (g) of France over Germany; (h) of Germany over Russia; (i) of Russia over Italy.

18. Leather of the top grade cost \$.35 a square foot in 1914 and \$1.50 a square foot in 1919. What part of the 1919 cost was the 1914 cost?

19. On September 19, 1919, the value of the English pound sterling dropped from the normal of \$4.8665 to \$4.155. How many pounds sterling could be purchased for \$100 at the normal rate? at the reduced rate? (Answer to nearest thousandth of a pound.)

20. On the same date the value of French money dropped to 8.95 francs to the dollar. What was the value of the franc in cents? How much less was this than the normal value of \$.193? (Answer to nearest hundredth of a cent.)

21. The German mark dropped from the normal value of \$.2383 to \$.0385. How many hundredths of the original value was the reduced value?

PERCENTAGE

The label on this bottle tells us that in 100 parts of the emulsion, 50 parts are cod liver oil.

Per cent means by the hundred or hundredths.
The sign for per cent is %.

We may express the per cent of a number either as a *common fraction* or as a *decimal*.



Thus, $6\% = \frac{6}{100} = .06$; 6 % of 500 means $\frac{6}{100}$ of 500, which equals 30. Or, $.06$ of 500 = 30.

The process of computing by hundredths is called **percentage**. It is simply an application of decimals.

Oral Work

1. What term in common fractions corresponds to the number before the sign %? to the sign %?

2. In the following expressions, what represents the *numerator*? the *denominator*?

1 %	20 %	40 %	100 %
6 %	30 %	75 %	125 %

3. Find 8 % of 100.

SOLUTION. $\frac{8}{100}$ of 100 = 8. Or, $.08 \times 100 = 8$.

Find :

- | | | |
|---------------------------|-----------------|------------------------------|
| 4. 5 % of 100 | 9. .10 of 100 | 14. .03 of 60 |
| 5. .05 of 100 | 10. 10 % of 100 | 15. 8 % of 75 |
| 6. $\frac{5}{100}$ of 100 | 11. 25 % of 100 | 16. .08 of 75 |
| 7. 6 % of 150 | 12. .25 of 400 | 17. $.33\frac{1}{3}$ of 300 |
| 8. .06 of 150 | 13. 3 % of 60 | 18. $33\frac{1}{3}\%$ of 300 |

How to change per cents to equivalents.

Oral Work

$5\% = .05 = \frac{5}{100} = \frac{1}{20}$. These expressions are **equivalents**.

Notice that the sign % takes the place of the decimal point; .25 = 25 % (not .25 %).

1. Give the fractional and the decimal equivalents of 10 %; of 6 %; 4 %; 20 %; 25 %.

Read the following equivalents:

2. $\frac{20}{100}$, 20 %, .20, $\frac{1}{5}$

3. $\frac{12\frac{1}{2}}{100}$, $12\frac{1}{2}\%$, $.12\frac{1}{2}$, $\frac{1}{8}$

4. $\frac{40}{100}$, 40 %, .40, $\frac{2}{5}$

5. $\frac{37\frac{1}{2}}{100}$, $37\frac{1}{2}\%$, $.37\frac{1}{2}$, $\frac{3}{8}$

6. $\frac{80}{100}$, 80 %, .80, $\frac{4}{5}$

7. $\frac{87\frac{1}{2}}{100}$, $87\frac{1}{2}\%$, $.87\frac{1}{2}$, $\frac{7}{8}$

8. Change $\frac{2}{5}$ to hundredths and to per cents.

$$\frac{2}{5} = 2 \div 5 = 5 \overline{)2.00} \\ .40, \text{ or } 40\%$$

9. Change $\frac{3}{8}$ to hundredths and to per cents.

$$\frac{3}{8} = 3 \overline{)3.00} \\ .37\frac{1}{2}, \text{ or } 37\frac{1}{2}\%$$

Change to hundredths and to per cents:

10. $\frac{1}{2}$

18. $\frac{3}{10}$

26. $\frac{3}{8}$

34. $\frac{1}{25}$

11. $\frac{1}{3}$

19. $\frac{7}{10}$

27. $\frac{5}{8}$

35. $\frac{3}{25}$

12. $\frac{2}{3}$

20. $\frac{9}{10}$

28. $\frac{1}{8}$

36. $\frac{7}{25}$

13. $\frac{1}{4}$

21. $\frac{1}{5}$

29. $\frac{1}{16}$

37. $\frac{1}{15}$

14. $\frac{3}{4}$

22. $\frac{2}{5}$

30. $\frac{1}{10}$

38. $\frac{1}{12}$

15. $\frac{1}{6}$

23. $\frac{3}{5}$

31. $\frac{3}{20}$

39. $\frac{5}{12}$

16. $\frac{5}{6}$

24. $\frac{4}{5}$

32. $\frac{7}{20}$

40. $\frac{7}{12}$

17. $\frac{1}{10}$

25. $\frac{1}{8}$

33. $\frac{9}{20}$

41. $\frac{1}{12}$

Give the products rapidly:

42. $2 \times .33\frac{1}{3}$

45. $5 \times .12\frac{1}{2}$

48. $4 \times .12\frac{1}{2}$

51. $4 \times .04\frac{1}{4}$

43. $5 \times .16\frac{2}{3}$

46. $7 \times .12\frac{1}{2}$

49. $6 \times .12\frac{1}{2}$

52. $3 \times .16\frac{2}{3}$

44. $3 \times .12\frac{1}{2}$

47. $3 \times .08\frac{1}{3}$

50. $2 \times .15$

53. $4 \times .16\frac{2}{3}$

54. Memorize the following table :

$\frac{1}{2} = 50\%$	$\frac{1}{5} = 20\%$	$\frac{5}{6} = 83\frac{1}{3}\%$	$\frac{7}{8} = 87\frac{1}{2}\%$
$\frac{1}{3} = 33\frac{1}{3}\%$	$\frac{2}{5} = 40\%$	$\frac{1}{7} = 14\frac{2}{7}\%$	$\frac{1}{9} = 11\frac{1}{9}\%$
$\frac{2}{3} = 66\frac{2}{3}\%$	$\frac{3}{5} = 60\%$	$\frac{1}{8} = 12\frac{1}{2}\%$	$\frac{1}{12} = 8\frac{1}{3}\%$
$\frac{1}{4} = 25\%$	$\frac{4}{5} = 80\%$	$\frac{3}{8} = 37\frac{1}{2}\%$	$\frac{5}{12} = 41\frac{2}{3}\%$
$\frac{3}{4} = 75\%$	$\frac{1}{6} = 16\frac{2}{3}\%$	$\frac{5}{8} = 62\frac{1}{2}\%$	$\frac{1}{16} = 6\frac{1}{4}\%$

Name rapidly the fractional equivalents, in lowest terms, of the following per cents :

- | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|
| 55. 50 % | 60. 20 % | 65. $37\frac{1}{2}\%$ | 70. 90 % |
| 56. $33\frac{1}{3}\%$ | 61. 40 % | 66. $62\frac{1}{2}\%$ | 71. $12\frac{1}{2}\%$ |
| 57. $66\frac{2}{3}\%$ | 62. 60 % | 67. $87\frac{1}{2}\%$ | 72. $16\frac{2}{3}\%$ |
| 58. 25 % | 63. $8\frac{1}{3}\%$ | 68. 10 % | 73. 80 % |
| 59. 75 % | 64. $83\frac{1}{3}\%$ | 69. 30 % | 74. 70 % |

Write the equivalents of the following in hundredths.

Thus, 1 % = .01; 32 % = .32; $\frac{1}{4}\%$ = .00 $\frac{1}{4}$; etc.

- | | | | |
|-----------------------|-----------------------|---------------------|-----------------------|
| 75. 5 % | 81. $\frac{5}{8}\%$ | 87. 50 % | 93. 13 % |
| 76. 34 % | 82. 3 % | 88. $\frac{2}{3}\%$ | 94. $13\frac{1}{3}\%$ |
| 77. $\frac{1}{5}\%$ | 83. 11 % | 89. 6 % | 95. $\frac{1}{8}\%$ |
| 78. 2 % | 84. $\frac{1}{4}\%$ | 90. $\frac{3}{4}\%$ | 96. 100 % |
| 79. $16\frac{2}{3}\%$ | 85. 4 % | 91. 7 % | 97. 123 % |
| 80. $\frac{1}{3}\%$ | 86. $43\frac{1}{2}\%$ | 92. $\frac{7}{8}\%$ | 98. 127 % |

99. Helen received 80 % in arithmetic, 100 % in spelling, and 90 % in grammar. What was her average per cent ?

100. The attendance was 80 % of the enrollment. What fractional part of the enrollment was it ?

How to find a given per cent of a number.**Oral Work**

NOTE. Think of $66\frac{2}{3}\%$ as $\frac{2}{3}$; of $83\frac{1}{3}\%$ as $\frac{5}{6}$, etc.

Find:

- | | |
|----------------------------|---------------------------------|
| 1. $66\frac{2}{3}\%$ of 18 | 9. $16\frac{2}{3}\%$ of \$6000 |
| 2. $33\frac{1}{3}\%$ of 90 | 10. $37\frac{1}{2}\%$ of \$7200 |
| 3. 50% of \$500 | 11. $12\frac{1}{2}\%$ of \$6400 |
| 4. 25% of \$2000 | 12. 80% of \$4800 |
| 5. 75% of 16 inches | 13. $66\frac{2}{3}\%$ of \$999 |
| 6. 20% of 100 yards | 14. $87\frac{1}{2}\%$ of \$160 |
| 7. 40% of 60 feet | 15. $62\frac{1}{2}\%$ of \$240 |
| 8. 60% of 40 miles | 16. $37\frac{1}{2}\%$ of \$880 |

17. One year the price of sirloin steak was 32¢ a pound. The next year it was 25% more. What was the increase in price?

18. In the Lincoln School $33\frac{1}{3}\%$ of the 150 pupils had vegetable gardens. How many gardens were there?

19. In a spelling examination of 50 words Martha's mark was 80%. How many words did she have right?

20. At a sale tablecloths were marked down $12\frac{1}{2}\%$ from \$8. What was the amount of reduction?

21. A school team played 25 games of baseball and won 60% of them. How many games were won?

22. John formerly earned 12¢ an hour by picking apples. This year he earned $66\frac{2}{3}\%$ more. How much more did he get this year?

23. The flour for a loaf of bread weighs 15 oz.; 20% of this is rye flour and 80% wheat flour. How many ounces of each kind are there?

In percentage the number of which some per cent is to be taken is sometimes called the **base**; the number of hundredths to be taken is called the **rate**; and the result obtained by taking the given number of hundredths is called the **percentage**.

Thus, in 5 % of \$200 = \$10, \$200 is the base, 5 % the rate, and \$10 the percentage.

The sum of the base and the percentage is called the **amount**; the difference between the base and the percentage is called the **difference**.

Thus, in the above illustration, the amount is \$200 + \$10, or \$210; the difference is \$200 - \$10, or \$190.

Written Work

1. What is 17 % of 245 ?

$$\begin{array}{r} 245 \\ .17 \\ \hline 41.65 \end{array}$$

17 % of the number equals .17
of it. .17 times 245 = 41.65.

2. What is $66\frac{2}{3}$ % of 300 ?

$$\frac{2}{3} \text{ of } \frac{100}{300} = 200$$

$66\frac{2}{3}$ % of a number equals $\frac{2}{3}$ of
it. $\frac{2}{3}$ of 300 = 200.

If we represent the base by the letter b , the rate by r , and the percentage by p , we have the following formula for finding a per cent of a number :

FORMULA: $p = r \times b$.

SOLUTION OF EX. 1 BY FORMULA. $p = r \times b = .17 \times 245 = 41.65$.

Find :

- | | | |
|------------------|--------------------|------------------------------|
| 3. 18 % of 328 | 6. 38 % of \$77.50 | 9. $14\frac{2}{3}$ % of 105 |
| 4. 19 % of \$126 | 7. 72 % of 328 | 10. 75 % of 400 |
| 5. 21 % of 263 | 8. 80 % of 6.75 | 11. $87\frac{1}{2}$ % of 168 |

Find :

- | | |
|---------------------------------|-------------------------------|
| 12. 16 % of \$ 200 | 17. 18 % of \$400 |
| 13. $33\frac{1}{3}$ % of 11 mo. | 18. 27 % of \$500 |
| 14. 60 % of 30 da. | 19. $3\frac{1}{3}$ % of \$99 |
| 15. 12 % of 150 A. | 20. 18 % of 150 lb. |
| 16. 15 % of 600 T. | 21. $1\frac{1}{2}$ % of \$ 75 |

22. How much was saved by buying a lamp at a reduction of 30 % if the regular price was \$12.50 ?

SOLUTION BY FORMULA. $p = r \times b = .30 \times \$12.50 = \$3.75$.

23. Paul had 80 words to spell. He missed 5 % of them. How many words did he miss ?

24. Edward earned \$ 18.60 by selling vegetables from his school garden and deposited $33\frac{1}{3}$ % of it in the school savings bank. How much did he deposit ?

25. An increase of 25 % was granted to a workman who earned \$4.20 a day. How much did he get then ?

SOLUTION. $\frac{1}{4}$ of \$4.20 = \$1.05; $\$4.20 + \$1.05 = \$5.25$.

26. Some policemen received an increase of 10 % on a salary of \$1500. How much did they earn then ?

27. The daylight saved by setting the clocks forward 1 hour from April to November reduced Mrs. Clarke's gas bill $33\frac{1}{3}$ % this year. Last year her bill was \$24.30. How much was it this year ?

SOLUTION. $\frac{1}{3}$ of \$24.30 = \$8.10; $\$24.30 - 8.10 = \16.20 .

28. By saving a shovelful of coal each day Mrs. Burt saved 10 % during this winter. Last winter she burned $9\frac{1}{2}$ tons. How much did she burn this winter ?

29. Father bought a house for \$4200 and spent $12\frac{1}{2}$ % of the cost on repairs. How much did the repairs cost ?

30. Ruth earned \$60.90 and put $66\frac{2}{3}$ % of it in the school savings bank. How much did she deposit ?

31. Eggs were sold at 50 ¢ a dozen on Monday and at 6 % more on Tuesday. What was the price on Tuesday ?

32. James earned \$16 in May by selling papers. If he increased his sales 25 % in June, how much were his sales for the month of June ?

33. A gas meter for March showed 5000 cu. ft. of gas used. The price was 80 ¢ per thousand cubic feet and an allowance of 10 % was made for payment before the 10th of the month. Find the amount to be paid on April 1.

34. Notice was posted in a mill Feb. 1 of an increase of 10 % in wages. If the wages in six different departments were \$3.60, \$3.70, \$3.80, \$3.90, \$4.00, and \$4.40 per day before Feb. 1, what were the wages after Feb. 1 in each department ?

35. Compare 48 % of \$45 with 45 % of \$48.

36. An automobile cost \$3500. It was sold after 2 years at a 40 % reduction from the cost. Find the loss.

37. The operating expenses of a factory were 45 % of the sales. If the sales for a year amounted to \$650,450, how much were the operating expenses ?

38. 400 men were employed in a factory at daily wages averaging \$3.60. If 100 of these men received $33\frac{1}{3}$ % of the entire daily wages, find their average daily wages. Find the average daily wages of the other 300 men.

39. Three newsboys earned together \$950 in a year. John earned 40 %, James, 35 %, and Henry, 25 %. Find how much each earned.

40. In one year the United States sent 260,000,000 bu. of cereals to her allies. The next year she sent 31 % more. How many bushels of cereals did she send the second year ?

41. People were permitted to pay for the bonds of the first issue of the Liberty Loan of 1917 as follows: 2 % on application, 18 % on June 28, 20 % on July 30, 30 % on Aug. 15; and 30 % on Aug. 30. Find the amount paid each time on a \$ 50 bond.

42. There are 20,000,000 families in the United States. If 60 % of them signed the pledge to save food, how many families signed this pledge?

43. One year Mr. Warner raised 240 bu. of potatoes per acre. The next year he succeeded in increasing the production by 15 %. Find the number of bushels per acre raised the second year.

44. Of 5000 tractors used on the farms of a certain state $2\frac{1}{2}$ % were owned by the state. How many were owned by the farmers?

SUGGESTION. $100\% - 2\frac{1}{2}\% = 97\frac{1}{2}\%$ owned by the farmers.

45. How much did an architect receive, at $4\frac{1}{2}$ %, for the plans of a house that cost \$ 8350?

46. It cost \$ 327 a year, exclusive of pay, to maintain an American soldier in this country and $29\frac{1}{2}$ % more to maintain him abroad. How much did it cost abroad?

47. In a school of 400 pupils, 45 % were girls. How many girls were there? how many boys?

48. A clerk who received \$ 80 a month had his wages increased 15 %. How much were his wages increased?

49. Iron ore yields 63 % of pure metal to the ton. How much iron is there in 40 tons of ore?

50. Our exports to Europe increased 141 % during the Great War. Before the war they amounted to \$ 6,600,000,000. What was their value during the war?

51. A city increased the street cleaners' pay from \$ 980 a year to 20 % more. Find the amount of increase.

52. Louise made jelly at a total cost of \$20. She sold it at a profit of 50 %. For how much did she sell it?

SUGGESTION. The *selling price* equals the cost *plus* the *profit*, or *less* the loss. In Ex. 52, add the profit (50 % of \$20) to the cost, \$20.

53. A rug was bought for \$200 and sold at a sale at a loss of 25 %. What was the selling price?

SUGGESTION. Subtract the loss (25 % of \$200) from the cost, \$200.

54. A bill of goods costing \$136.50 was sold at a profit of 12 %. Find the selling price.

55. A merchant sold a lot of goods costing \$12,000, at 22 % above cost. How much did he gain?

Find the gain or the loss and the selling price :

56. Cost \$75, gain 20 %. 60. Cost \$356, gain 21 %.

57. Cost \$96, gain $33\frac{1}{3}$ %. 61. Cost \$132.50, gain 28 %.

58. Cost \$115, loss 15 %. 62. Cost \$485.60, loss 5 %.

59. Cost \$227, loss 19 %. 63. Cost \$880.80, gain $12\frac{1}{2}$ %.

Business men distinguish between the **gross profit**, which is the difference between the selling price and the cost of the goods, and the **net profit**, which is the difference between the total receipts and the total expenses. Such charges as rent, light, heat, insurance, taxes, salaries of officers, etc., are called **overhead charges**.

64. A merchant bought a quantity of serge for \$2000 and sold it for \$3500. Allowing 30 % of the cost for overhead charges, what was his net profit?

SOLUTION. $.30$ of \$2000 = \$600; \$2000 + \$600 = \$2600, total cost; \$3500 - \$2600 = \$900, net profit.

65. Find the net profit on goods bought for \$5000 and sold for \$8000, allowing 25 % of the cost for expenses.

66. What was the net profit on goods bought for \$3600 and sold for \$5800, allowing 30 % of the cost for expenses?

67. A house bought for \$6400 was sold at a profit of 25 % after expenses of \$116 had been paid. Find the selling price.

How to find what per cent one number is of another number, or the rate.

Oral Work

1. What part of 8 is 4? What per cent of 8 is 4?

SOLUTION. 4 is $\frac{1}{2}$ of 8, or 50 % of 8.

What per cent of:

2. 10 is 5?

4. 30 is 10?

6. 30 is 20?

3. 20 is 5?

5. 12 is 10?

7. 100 is 10?

8. Food which could be bought in 1913 for \$1 in 1919 cost \$1.85 in Washington, \$1.77 in Philadelphia, \$1.68 in New York, and \$1.58 in San Francisco. Find the per cent of increase in each case.

SUGGESTION. The increase in Washington was \$1.85 - \$1.00, or \$.85. \$.85 = .85, or 85 %, of \$1.

Written Work

1. What per cent of 75 is 15?

$15 \div 75 = .2$, or 20 % 15 is $\frac{1}{5}$ of 75. Reduce the fraction $\frac{1}{5}$ to per cent by dividing 15 by 75.

Since $20 = 4 \times 5$, $4 = 20 \div 5$.

Since $20 = .04 \times 500$, $.04 = 20 \div 500$.

Since $p = r \times b$, $r = p \div b$.

FORMULA: $r = p \div b$.

SOLUTION OF EX. 1 BY FORMULA. $r = p \div b = 15 \div 75 = .2$, or 20 %.

What per cent of:

2. 25 is 10?

7. 96 is 72?

12. 25 is 5?

3. 32 is 12?

8. 25 is $6\frac{1}{4}$?

13. 100 is $33\frac{1}{3}$?

4. 60 is 40?

9. 75 is 25?

14. 60 is 18?

5. 125 is 75?

10. 9 is 5?

15. 18 is 60?

6. 20 is 6?

11. 240 is 90?

16. 50 is 200?

NOTE. Find all per cents to the nearest tenth per cent. Thus, regard 9.44 % as 9.4 % and 9.45 %, 9.46 %, etc., as 9.5 %.

17. If I spelled 20 words out of 25 words correctly, what per cent did I get on the test?

SOLUTION BY FORMULA. $r = p \div b = 20 \div 25 = .8$, or 80 %.

18. Walter sold 60 out of 100 chickens that he raised. What per cent of his chickens did he sell?

19. The price of sirloin steak rose from \$.27 a pound one year to \$.36 a pound the next year. What was the per cent of increase?

SUGGESTION. The increase, \$.09, was what per cent of \$.27? The increase or decrease must be reckoned on the *original number or amount*.

20. What per cent of a quart is a pint?

21. What per cent of a yard is a foot?

22. What per cent of a gallon is a quart? a pint?

23. What per cent of a pound is an ounce?

24. What per cent of a foot is an inch?

25. A farmer raised 150 bu. of potatoes from 6 bu. of seed. What per cent of the crop was the seed?

Find the per cent of reduction in the following sales.

	REG. PRICE	SALE PRICE		REG. PRICE	SALE PRICE
26. Table Lamps	\$18.50	\$10.50	30. Tablecloths	\$ 8.00	\$6.50
27. Floor Lamps	12.50	8.95	31. Linen sheets	12.50	9.50
28. Dinner Sets	17.50	14.50	32. Napkins per doz.	7.00	5.00
29. Tea Sets	12.25	8.75	33. Towels per doz.	9.00	6.75

SUGGESTION. The decrease on table lamps, \$18.50 - \$10.50, or \$8, is what per cent of \$18.50? First *estimate* the answer, $\frac{8}{18.5} = \frac{1}{2}$, or 44 %.

Find the per cent of increase on the following articles :

	FORMER PRICE	PRESENT PRICE
34. Felt hats	\$9 a dozen	\$27 a dozen
35. Suède gloves	7.25 a dozen	16.50 a dozen
36. Woolen gloves	3.50 a dozen	9.50 a dozen

	FORMER PRICE	PRESENT PRICE
37. Sheeting	4¢ a yard	18½¢ a yard
38. Muslin	5¢ a yard	21¢ a yard
39. Handkerchiefs	35¢ each	\$1.00 each

40. A turnip that weighed 10 oz. contained 9 oz. of water. What per cent of the turnip was water?

41. A war savings certificate stamp cost \$4.20. What per cent of a \$50 Liberty bond was this?

42. Out of 40 chickens that James had, he succeeded in raising only 25. What per cent of chickens did he lose?

43. Ruth raised strawberries at a cost of \$215 and a profit of \$180. Find the rate of profit.

44. A man bought for \$4000 cash a farm valued at \$5000. What per cent of the value of the farm did he save by paying cash?

45. A bag of potatoes that weighed 100 lb. in September weighed 95 lb. in April after drying out. What per cent of the weight of the potatoes was lost in drying out?

46. The total amount of subscriptions offered in the First Liberty Loan was \$3,035,226,850. What per cent was this above the authorized issue of \$2,000,000,000?

47. A merchant bought a quantity of serge for \$2500 and sold it for \$3000. (a) What per cent of the cost was the gain? (b) What per cent of the selling price was the gain?

SOLUTION. The gain was \$3000 - \$2500, or \$500. (a) \$500 is $\frac{500}{2500}$, or 20 %, of the cost, \$2500; (b) \$500 is $\frac{500}{3000}$, or $16\frac{2}{3}$ %, of the selling price, \$3000. The per cent of gain or loss is reckoned by some business houses on the cost; by others on the selling price. In this book the cost is taken as the base, unless otherwise specified.

48. When goods costing \$8000 are damaged by fire and sold for \$6000, what per cent of the cost is lost?

49. A farm was bought for \$3500 and sold for \$4200. What per cent of the cost was gained?

Calculate the per cent of gain or loss :

	BOUGHT FOR	SOLD FOR	PER CENT OF GAIN OR LOSS
50.	\$ 1.20	\$ 1.60	?
51.	2.80	2.40	?
52.	4.00	6.00	?
53.	3.50	5.00	?
54.	1.20	1.50	?
55.	100.00	80.00	?
56.	12.50	15.00	?
57.	1.05	.90	?
58.	15.00	12.00	?
59.	.90	.60	?

60. A real estate agent bought two lots at \$1200 each. He sold one lot for \$1500. What per cent did he gain? He sold the other lot for \$1000. What per cent did he lose?

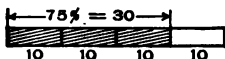
61. A furniture dealer bought two bookcases at \$140 each. He sold one for \$168 and the other for \$175. What per cent did he gain in each case?

How to find a number when a per cent of it is given.

NOTE. Pages 41 and 42 may be deferred if the teacher thinks best.

Oral Work

1. If $\frac{1}{5}$ of a number is 10, what is the number? If 20% of a number is 10, what is the number?



2. If $\frac{3}{4}$, or 75%, of a number is 30, what is the number?

3. If $33\frac{1}{3}\%$ of a man's loss is \$300, what is his loss?

What is the number of which:

- | | | |
|---------------------------------|--------------------------------|---------------------------------|
| 4. \$100 is $33\frac{1}{3}\%$? | 8. 40 is $16\frac{2}{3}\%$? | 12. \$48 is 10%? |
| 5. 10 is $66\frac{2}{3}\%$? | 9. 100 is $12\frac{1}{2}\%$? | 13. \$12 is $16\frac{2}{3}\%$? |
| 6. 500 is 50%? | 10. 300 is $37\frac{1}{2}\%$? | 14. 30 is $33\frac{1}{3}\%$? |
| 7. 300 is 60%? | 11. 500 is 25%? | 15. \$10 is $83\frac{1}{3}\%$? |

Written Work

1. An increase of 15% in the price of an automobile amounted to \$240. What was the original price?

\$240 ÷ .15 = \$1600 The unknown number is the *base*. Since the percentage equals the base *multiplied* by the rate, the base equals the percentage *divided* by the rate, \$240 ÷ .15 = \$1600.

Test. .15 of \$1600 = \$240.

2. If 75% of a number equals 300, what is the number?

$$75\% = \frac{3}{4}$$

75% of a number equals $\frac{3}{4}$ of it. The number = $300 \div \frac{3}{4}$, or 400.

$$300 \div \frac{3}{4} = \frac{100}{\cancel{300}} \times \frac{4}{3} = 400$$

Test. $\frac{3}{4}$ of 400 = 300.

FORMULA:

$$b = p \div r.$$

SOLUTION OF EX. 1 BY FORMULA. $b = p \div r = \$240 \div .15 = \$1600.$

3. A 5% increase in salary equaled \$7 a month. What was the original salary?

SUGGESTION. $.05 \times \text{salary} = \7 . Hence $\$7 \div .05 = \text{salary}$.

4. An increase of 20% made by a railroad company to the wages of its employees amounted to \$2,500,000. What was the amount of the payroll before the increase?

Find the number if:

5. 8% of it is \$2.40

10. 6% of it is \$72

6. 12% of it is \$3.60

11. 32% of it is \$3.84

7. $12\frac{1}{2}\%$ of it is \$91

12. 45% of it is \$3.60

8. $37\frac{1}{2}\%$ of it is \$27

13. 62% of it is \$35.96

9. $33\frac{1}{3}\%$ of it is \$42.50

14. $87\frac{1}{2}\%$ of it is \$28.28

15. Peter had 16 examples right in a test and his mark was 80%. How many examples were there in the test?

16. A conductor's pay was increased 64 cents a day, or 20%. What was his original pay?

17. Mother paid \$6 less for light in 1919 than in 1918. This was a saving of 12%. What was the expense in 1918?

18. After a battle 70% of a regiment, or 644 men, were left. How many men were there in the regiment at first?

19. After an increase of 10% a teacher's salary was \$2200. How much was it before the increase?

SOLUTION. $100\% + 10\% = 110\%$. $\$2200 = 110\%$ of the original salary. Hence the original salary was $\$2200 \div 1.10$, or \$2000.

20. A lamp was sold at a sale for \$9, which was 25% less than the original price. What was the original price?

SOLUTION. $100\% - 25\% = 75\%$, or $\frac{3}{4}$. $\$9 = \frac{3}{4}$ of the original price. Hence the original price = $\$9 \div \frac{3}{4}$, or \$12.

21. The land surface of the District of Columbia is 60 square miles, which is 500% more than the water surface. What is the water surface?

EVERYDAY USE OF NUMBERS

Basketball and Baseball



Find the per cent of games won by each basketball team:

	WON	LOST		WON	LOST
1. Arlington School	9	1	5. Newton Academy	3	9
2. Bruce Institute	8	2	6. Glendale School	2	10
3. Warner School	7	4	7. Murray Seminary	8	3
4. Perry Seminary	10	2	8. Walden Club	9	3

Find the per cent of games won by each baseball team:

TEAM	WON	LOST	TEAM	WON	LOST
9. Chicago	100	54	13. Washington	74	79
10. Boston	90	62	14. New York	71	82
11. Cleveland	88	66	15. St. Louis	57	97
12. Detroit	78	75	16. Philadelphia	55	98

17. Find the batting average of player Clarke, at bat 400, hits 150.

SOLUTION. $\frac{150}{400} = 37\frac{1}{2}\%$. This is expressed in baseball tables as .375

What was the batting average of the following players?

SUGGESTION. $\frac{1}{4} = ?\%$

	AT BAT	HITS		AT BAT	HITS
18. Roush	522	178	22. Neale	385	113
19. Wheat	362	113	23. Fischer	245	70
20. Burns	597	180	24. Magee	383	107
21. Smith	462	137	25. Mitchell	90	25

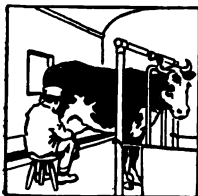
Club Champion Boys and Girls



Find, to the nearest tenth per cent, the per cent of profit made by the following club champion boys and girls. Find also, to the nearest cent, the profit per bushel, pound, etc.

NAME	CHAMPIONSHIP	YIELD	COST OF PRODUCTION	PROFIT
1. Roy Halverson	Corn	115.7 bu.	\$ 23.55	\$ 79.00
2. Fred Thomas	Corn	116.53 bu.	10.40	59.55
3. Frank Rimel	Corn	148.00 bu.	39.57	87.50
4. Earl Zeller	Corn	139.00 bu.	12.15	197.80
5. Eloise Parsons	Canning	5318 lb.	15.61	115.57
6. Beatrice Speers	Canning	5175 lb.	27.70	114.05
7. Sarah Dickinson	Canning	4966 lb.	12.33	78.01
8. Sarah Anders	Canning	4400 lb.	12.10	31.90
9. Amos Carroll	Potatoes	262.00 bu.	49.00	81.52
10. Ivan Zeller	Potatoes	258.67 bu.	30.00	29.05
11. Lawrence Estes	Potatoes	440.00 bu.	112.00	203.60
12. Arthur Bent	Poultry	100 doz. eggs	14.30	22.52
13. Eugene Davis	Sugar beets	12 T.	17.05	42.95
14. William Peterson	Sugar beets	16½ T.	36.85	44.40
15. Elmer Cole	Onions	6000 lb.	24.45	95.55
16. William Ward	Onions	8565 lb.	31.97	53.68
17. Roy Smith	Strawberries	5800 qt.	215.40	179.40
18. Alfred Nelson	Carrots	3600 lb.	14.60	57.40
19. Ruth Fleek	Tomatoes	1000 lb.	11.29	81.92
20. Beatrice Speers	Tomatoes	2524 lb.	18.00	67.05
21. Violet Miller	Tomatoes	2300 lb.	9.03	26.72
22. Golden Spence	Poultry	13 chickens	3.30	13.20
23. Anita Scheppers	Poultry	14 chickens	3.70	14.30
24. Kenneth Witt	Poultry	12 chickens	1.30	6.70

Farm Problems



1. A cow whose milk tested 4 % butter fat gave 4200 lb. of milk a year. How many pounds of butter fat did the cow produce ?

SUGGESTION. 4 % of 4200 lb. = ?

Find the number of pounds of butter fat produced by each of the following cows in one month :

	Cow	LB. MILK	% BUTTER FAT		Cow	LB. MILK	% BUTTER FAT
2.	No. 1	600	3.9	5.	No. 4	550	4.3
3.	No. 2	540	3.4	6.	No. 5	700	4.1
4.	No. 3	670	4.0	7.	No. 6	650	3.6

8. The champion cow, Glenwood Girl, produced 12,187 lb. of milk yielding 572 lb. of butter fat. Find the per cent of butter fat. $\frac{572}{12187} = ?\%$

9. May Rilma produced 19,673 lb. of milk yielding 1073 lb. of butter fat. Find the per cent of butter fat.

10. Murne Cowan produced 24,008 lb. of milk yielding 1098 lb. of butter fat. Find the per cent of butter fat.

11. Creamelle Vale produced 29,591 lb. of milk yielding 924 lb. of butter fat. Find the per cent of butter fat.

12. A farmer harvested 240 bu. of potatoes, but $12\frac{1}{2}\%$ of them were frozen. How many bushels were frozen ?

13. John raised 80 bu. ears of corn on one acre one year. By using better methods of farming, he raised 110 bu. ears the next year. Find the per cent of increase.

COMMERCIAL DISCOUNT

Oral Work

1. George paid \$.50 for his reader; but he kept it in good condition and when he was through with it, sold it to Robert at 40 % less than he paid for it, that is, at a **discount** of 40 %. How much did Robert pay for the book ?

SOLUTION. The discount that Robert received was 40 % of \$.50 or \$.20; therefore he paid \$.50 - \$.20, or \$.30, for the reader.

At bargain sales, when merchants wish to dispose quickly of goods, they sell them at a discount.

Any deduction from a stated price is called a **discount**.

The prices in retail price lists are usually higher than the wholesale prices and are subject to deductions called **trade discounts** or **commercial discounts**.

The price less all discounts is called the **net price**.

Find the net prices paid for goods marked as follows :

- | | | |
|-------------------|-------------------|-------------------|
| 2. \$15 less 20 % | 4. \$40 less 60 % | 6. \$30 less 10 % |
| 3. \$20 less 40 % | 5. \$48 less 25 % | 7. \$90 less 50 % |

Supply the missing numbers :

	LIST PRICE	RATE OF DISCOUNT	NET PRICE		LIST PRICE	NET PRICE	RATE OF DISCOUNT
8.	\$ 80	25 %	?	16.	\$ 54	\$45	?
9.	100	50 %	?	17.	25	20	?
10.	450	20 %	?	18.	12	10	?
11.	600	33 $\frac{1}{3}$ %	?	19.	3	2	?
12.	12	16 $\frac{2}{3}$ %	?	20.	40	30	?
13.	32	12 $\frac{1}{2}$ %	?	21.	50	30	?
14.	50	20 %	?	22.	12	9	?
15.	150	20 %	?	23.	4	3	?

Written Work

Find the net prices paid for the following goods, counting any part of a cent as an additional cent:

- | | |
|-------------------------------------|---------------------------------------|
| 1. \$168.75, less 25 % | 11. \$875.50, less 30 % |
| 2. \$1374, less $16\frac{2}{3}$ % | 12. \$278.90, less 10 % |
| 3. \$1872, less $33\frac{1}{3}$ % | 13. \$2378.50, less 4 % |
| 4. \$278.40, less $37\frac{1}{2}$ % | 14. \$6775.20, less 5 % |
| 5. \$3030, less 40 % | 15. \$8888.88, less $12\frac{1}{2}$ % |
| 6. \$225.65, less 20 % | 16. \$4255.75, less 40 % |
| 7. \$500.40, less 50 % | 17. \$1000, less $6\frac{1}{2}$ % |
| 8. \$820.60, less 60 % | 18. \$2000, less $5\frac{1}{2}$ % |
| 9. \$330.30, less $66\frac{2}{3}$ % | 19. \$8000, less $2\frac{1}{4}$ % |
| 10. \$700.50, less 20 % | 20. \$12,000, less $8\frac{1}{8}$ % |

The A. B. Orr Company in Lynn, Mass., advertised the following goods. Find the per cent of discount on each:

	LIST PRICE	NET PRICE	PER CENT OF DISCOUNT
21.	\$35.00 suits	\$28.00	?
22.	\$.12 $\frac{1}{2}$ ribbon	.10	?
23.	\$20.00 boys' suits	15.00	?
24.	\$6.00 girls' trimmed hats	4.00	?
25.	\$8.00 girls' shoes	6.00	?
26.	\$2.00 dress goods	1.50	?
27.	\$8.00 remnant	4.00	?
28.	\$.40 ribbon	.30	?
29.	\$24.00 girls' suits	18.00	?
30.	\$240.00 piano player	160.00	?
31.	\$6.00 shoes	4.50	?
32.	\$7.50 tablecloths	6.00	?

EVERYDAY USE OF NUMBERS

Buying at Bargain Sales



How much is saved on the following bargain sales?

	REGULAR PRICE	PER CENT OF DISCOUNT	AMOUNT SAVED
1. Serge	\$ 2.00 a yard	25 %	
2. Silk	1.50 a yard	33 $\frac{1}{3}$ %	
3. Velvet	2.40 a yard	25 %	
4. Overcoats	45.00	33 $\frac{1}{3}$ %	
5. Boys' suits	12.00	25 %	
6. Ladies' suits	50.00	40 %	
7. Trimmed hats	10.00	50 %	
8. Rugs	60.00	33 $\frac{1}{3}$ %	
9. Bedroom suites	60.00	16 $\frac{2}{3}$ %	

Find the per cent of discount on the following purchases:

	REGULAR PRICE	SELLING PRICE	PER CENT OF DISCOUNT
10. Knitting bags	\$ 5.00	\$ 2.00	
11. Knitting wool, per hank	1.00	.75	
12. Boys' suits	18.00	13.50	
13. Girls' shoes	3.00	2.40	
14. Boys' caps	1.00	.60	
15. Men's overcoats	32.00	24.50	
16. Mink fur sets	125.00	80.00	
17. Shoes	7.00	5.75	

DISCOUNTING BILLS

Merchants and manufacturers frequently offer an extra discount from their bills if cash is paid at the time of purchase or within a certain time. This is called a **cash discount**. Cash discounts are always mentioned in connection with the *terms of payment*.

1. I pay cash for a bill of goods, and thereby get 10 % discount, or \$12.50. Find the amount of the purchase. Why is this a cash discount?

2. A dealer sells \$75 worth of goods at 5 % discount if paid within 60 days, or 10 % if paid in cash. Explain the different kinds of discount, and tell the amount saved by paying cash.

Business houses print on their billheads their terms of credit. For example :

(1) "Terms: 60 days net; 3 % off 10 days."

(2) "Terms: 90 days net; 60 days 2 %; 10 days 5 %."

(3) "Terms: 30 days net; cash 5 %."

3. Baird Brothers purchase of The Utility Company \$300 worth of merchandise. Terms: 60 days net; 5 % off 10 days. Find the discount if paid within 10 days.

4. I buy \$600 worth of goods. Terms: 30 days net; 5 % off for cash. Find the amount I save by paying cash.

5. \$200 worth of goods are bought Aug. 11, 1919. Terms: 60 days net; 5 % off 30 days; 10 % off 10 days. Find the amount saved by payment Sept. 6.

6. The Hall Company buy \$1500 worth of merchandise. Terms: 90 days net; 2 % off 60 days; 5 % off 30 days; 10 % off cash. What is the amount of the bill if cash is paid?

7. A bill of goods for \$200 is sold at 10 % off for cash; 5 % for 60 days; or 2 % for 90 days. Find each discount.

SUCCESSIVE TRADE DISCOUNTS

Wholesale merchants and manufacturers usually have price lists for their goods from which the retailer gets a certain **trade discount**. If a reduction from these prices is to be made, an extra discount is taken from the former discount price.

1. Find the net price of a bill of goods for \$75.40, trade discounts 20 %, 10 %.

List price,	\$75.40
Less 20 %,	15.08
First remainder,	60.32
Less 10 %,	6.03
Net price,	\$ 54.29

Observe that the *second* discount is reckoned on the *first* remainder. As there are only two discounts, the second remainder is the net price.

2. If a further discount of 10 % is allowed for cash, what is the net price of the goods?

NOTE. The *trade discount* is first deducted; then the *cash discount* is taken from the remainder.

Find the net price of articles listed at:

3. \$400, less 20 %, 10 %.
4. \$375.50, less 25 %, 5 %.
5. \$290.80, less 40 %, 10 %.
6. \$10.75, less 40 %, 5 %.
7. \$6.80, less 25 %, 10 %.
8. \$12.75, less 33 $\frac{1}{3}$ %, 10 %.
9. \$348, discount 20 %, 10 %, 5 %.
10. \$100, discount 10 %, 5 %, 2 %.

Find the net price of the following bills of goods:

11. 36 dozen boys' caps @ \$6, discounts 25 %, 20 %.
12. 50 buggies @ \$120, discounts 20 %, 15 %.
13. 75 sets harness @ \$40, discounts 30 %, 10 %.
14. A merchant buys 12 stoves listed at \$45, less 40 %, 10 %. Find the net amount of the bill. Compare this with the net amount of the bill with only one discount of 50 %.

15. What is the cost of a bill for \$42 with discounts of 20 % and 5 % ?

SUGGESTION. $100\% - 20\% = 80\%$. The total discount expressed in per cent is $20\% + (5\% \text{ of } 80\%)$, or 24 %. 24 % of \$42 = ?

16. What is the cost of a bill of farming implements listed at \$480, discounts 50 %, 5 %, and freight \$3.60 ?

What single discount equals the two discounts of 50 % and 5 % ?

17. Goods marked \$50 are bought at 10 % trade discount, 2 % off for cash. If sold at \$55, what is the rate of gain ?

18. A dealer buys 50 gross of buttons @ \$1.20, with 25 %, 10 %, and 5 % off. How much does he pay for them ?

19. A grocer is offered by one firm a discount of 10 % on \$1000, by another firm two successive discounts of 5 % on the same bill. Which is the better offer and how much ?

20. What is the difference between a discount of 15 % and 5 %, on a bill of \$2000, and a discount of 5 % and 15 %, on the same bill ? Show that the same result is obtained from any number of discounts on a bill in whatever order they are taken.

21. Three firms bid on the glass for a building as follows:

(1) \$2000, 60 %, 20 % off. (2) \$2100, 70 %, 10 % off. (3) \$2400, 80 %, 10 % off. Which offer is the best and how much ?

22. A jobber buys merchandise listed at \$1500, at 20 %, 15 % off, and sells at 15 %, 10 %, 5 % off. Find his profit.

23. A merchant purchases \$2000 worth of goods, trade discount 20 %, cash 5 %. He pays cash plus \$5.95 freight. What is the entire cost of the goods ?

24. Find a single discount equal to successive discounts of 40 %, 20 %, 10 %.

COMMERCIAL BILLS

COMMERCIAL BILLS

NOTE. A commercial bill differs from an ordinary bill in introducing the element of discount.

1. On May 10, 1919, Edward Holt, Atlanta, Georgia, bought of The Crane Company, 35 dozen bronze locks at \$5.50 a dozen, less 20 %, 10 %. Terms: 30 days net; 5 % off 10 days.

Form of Bill

ATLANTA, GEORGIA, <i>May 10, 1919.</i>			
<i>Mr. Edward Holt,</i>			
<i>Atlanta, Georgia.</i>			
Bought of THE CRANE COMPANY,			
HARDWARE MERCHANTS.			
TERMS: 30 days net; 5 % off 10 days.			
	35 doz. Bronze Locks @ \$ 5.50	\$ 192 50	
	Less 20 %, 10 %	53 90	
		138 60	
	Cash, 5 %	6 93	\$ 131 67
<i>Received payment, May 15, 1919</i>			
<i>The Crane Company.</i>			

In the above problem, since The Crane Company received payment within 10 days, a cash discount of 5 % was deducted from the \$138.60, making the payment \$131.67. Had the bill not been paid for thirty days, the net amount would have been \$138.60.

2. Rogers and Co., Ogden, Utah, ordered from Bliss and Sons, Chicago, Illinois, 10 doz. lawn mowers, list \$10 each, less 40 %, 20 %. Terms: 60 days net; 5 % off 10 days. Make out receipted bill if paid in 10 days.

3. Ralph Phillips, Boise, Idaho, ordered from the Merrit Company, Topeka, Kansas, 12 buggies, list price \$100 each, less 40 %, 20 %. Terms: 30 days net; 2 % off 10 days. Make out receipted bill if paid in 10 days.

4. Thompson Brothers, Auburn, Maine, ordered from the Butler Company, Barre, Vermont, the following, discount $33\frac{1}{3}$ %: 1 gas range, \$32.00; 100 ft. hose at \$.15 a foot; 24 garden rakes at \$.50 each. Terms: 30 days net; 2 % off 10 days. Make out receipted bill if paid in 30 days.

5. The M. L. Dudley Company, Boone, Iowa, bought of the Farwell Company, Dayton, Ohio, Aug. 4, 1919, on account 30 days net; 2 % off 10 days: 1500 ft. of galvanized pipe at \$.30 a foot, less 30 % and 10 %; 200 valves at \$.50 each; 200 elbows at \$.15 each, less 10 % and 10 %. Find the net amount of the bill if paid Aug. 20, 1919.

6. William Gainer and Sons, Akron, Ohio, sold to George Mason, Detroit, Michigan, April 9, 1919, on account 30 days net; 2 % off 10 days: 50 cultivators at \$25 each, less 40 % and 10 %; 13 mowers at \$75 each, less 30 % and 10 %. Find the net amount of the bill if paid April 25, 1919.

7. The Burroughs Company of Butte, Montana, bought from The Wyatt Company, Denver, Colorado, July 9, 1919, on account 60 days net, 5 % off 10 days: 3 pianos at \$450 each, less 40 %; 5 pianos at \$575 each, less 30 %; and 2 pianos at \$300 each, less 40 %. Find the net amount of the bill if paid Sept. 1, 1919.

8. J. B. Andrews, Athens, Georgia, sold to James Black, Athens, Georgia, July 2, 1919, on account 60 days net; 4 % off 10 days: 10 sewing machines at \$60 each, less $33\frac{1}{3}$ %; and 20 sewing machines at \$70 each, less 25 %. Find the net amount of the bill if paid within 10 days.

ACCOUNTS

In the study of bills we simply found how much the debtor owed to the seller, or what one party owed to another for services rendered.

In an **account** we have a record of business transactions covering a period of time in which there are both a debtor's *bills* and a debtor's *payments*.

Form of Statement of Account

		CHICAGO, ILL., May 1, 1919.			
		Mr. Samuel Cutler,			
		Oak Park, Ill.			
		TO THE SLOAN COMPANY, Dr.			
		Dr			
Apr.	1	To Account rendered	\$ 110 29		
"	10	" 20 yd. silk @ \$1.50	30 00		
"	25	" 2 Ladies' suits @ \$45.00	90 00		
"	29	" Mdse.	7 80	238 09	
		Cr.			
"	15	By Cash	100 00		
"	24	By Cash	60 00	160 00	
		Balance due The Sloan Co.		78 09	

NOTE. If the above balance were paid in full May 1, the words "Received Payment" would be followed by the signature

THE SLOAN COMPANY,

Per _____

It is customary for the creditor to send an itemized account to the debtor. If it is not paid, another form of statement is sent, which contains only these words: "To account rendered" or "To Mdse.," followed by the amount.

Render the following statements :

1. Jan. 31, 1919, the debits and credits of Arthur Wise in account with H. M. Taylor, Detroit, Mich., were as follows :

DEBITS

Jan. 2, To account rendered, \$295.63,
Jan. 7, To 3 overcoats @ \$32,
Jan. 14, To 7 yd. dress goods @ \$4.75,
Jan. 31, To 1 suite of furniture, \$185.

CREDITS

Jan. 6, By cash, \$250,
Jan. 20, By check, \$200,

Find the balance due H. M. Taylor.

2. Oct. 31, 1919, the debits and credits of R. D. Macy with The Walters Company, Memphis, Tenn., were as follows :

DEBITS

Oct. 1, To account rendered, \$86.25,
Oct. 11, To 12 cases corn @ \$1.65,
Oct. 18, To 4 bbl. sugar, 1692 lb., @ 8¢,
Oct. 22, To 75 lb. dry beef @ 39¢.

CREDITS

Oct. 6, By cash, \$85,
Oct. 30, By note for balance due.

3. On Dec. 31, the account of Roger Eaton with Henry Sayre, Dayton, Ohio, was as follows :

DEBITS

Dec. 2, To mdse., \$93.37,
Dec. 9, To mdse., \$107.62,
Dec. 22, To mdse., \$21.58.

CREDITS

Dec. 10, By cash, \$80,
Dec. 20, By check, \$100,
Dec. 31, By cash, \$25.

LEDGER ACCOUNTS

Daily records of business transactions are first made in a book of original entry, such as a journal or a cash book. Later each customer's record is transferred to a book called a **ledger**, which is *balanced* when an account is paid in full.

A ledger account is headed by the name of the customer and is so arranged that the *purchases* appear on the *left* side as **debits**, and the *payments* or *services rendered* on the *right* side as **credits**. Dollar signs are usually omitted.

The statement of account on page 54 is simply a copy of Mr. Cutler's ledger account with The Sloan Company.

The following form shows a ledger account with John Hartly, balanced at the close of the month, the balance being brought down to continue the account to the next month.

Dr.					John Hartly					Cr.				
1919					1919									
Feb.	1	Bal. bro't f'w'd		19 30	Feb.	6	Cash	6*	30	00				
"	3	Lumber	2*	19 80	"	11	Drayage	45	15	75				
"	4	Cement	8	40 50	"	18	Drayage	60	8	50				
"	5	Sand	15	9 50	"	22	Drayage	70	26	50				
"	8	Tile	30	15 70	"	25	Cash	74	82	50				
"	14	Plaster	50	56 30	"	28	Balance		38	75				
"	18	Sewer pipe	60	20 90										
"	26	Lumber	75	20 00										
				202 00								202	00	
Mch.	1	Bal. bro't f'w'd		38 75										

1. What debts in this ledger account did Mr. Hartly incur during the month? What payments did he make?

* These numbers refer to the pages in the book of original entry in which the records are found.

2. Find the sum of the debits and the sum of the credits. Does the difference equal the balance, \$38.75?

3. Is the balance in favor of or against Mr. Hartly?

4. Had the balance been in favor of Mr. Hartly, on which side would it have been entered?

5. How do you determine on which side to enter the balance? on which side to bring down the balance?

To **foot** a ledger is to add and set down (usually in pencil) the total debits and credits of the accounts.

Test. When the footing of one side equals the footing of the other side, the account is balanced.

Written Work

The original books show the following sales and receipts. Make a ledger for the year, enter each item, foot and close the accounts.

1. Charles Haskell.

DEBITS. — Feb. 1, cook stove, \$22; Feb. 4, nails, \$2.40; Feb. 5, heater, \$75.70; Feb. 12, tin roofing, \$79.08; Feb. 19, hardware, \$14; Feb. 24, lime and cement, \$50.70; Feb. 28, tile, \$22.

CREDITS. — Feb. 1, sand, \$15; Feb. 4, drayage, \$9.50; Feb. 13, cash, \$50; Feb. 17, lumber, \$74.25; Feb. 25, cash, \$20; Feb. 28, cash, \$105.

2. Robert Fiske.

DEBITS. — Apr. 2, mdse., \$15.90; Apr. 4, lumber, \$190.72; Apr. 5, mdse., \$23.15; Apr. 8, wagon, \$90; Apr. 16, mdse., \$20.70; surrey, \$129.70; Apr. 22, mdse., \$40.05; Apr. 25, cash, \$100; Apr. 30, lumber, \$189.

CREDITS. — Apr. 10, labor, \$129.71; Apr. 14, cash, \$75; Apr. 21, labor, \$29.70; Apr. 23, cash, \$147; Apr. 28, labor, \$270.20; Apr. 29, stone work, \$175.39; Apr. 30, cash, \$70.

COMMISSION AND BROKERAGE

Oral Work

1. Philip picked apples for Mr. Drake and received as pay, or **commission**, 10 % of the amount for which they were sold. How much did he receive if they were sold for \$40?

SOLUTION. 10 %, or $\frac{1}{10}$, of \$40 = \$4, commission.

2. Arthur collected \$1000 rent and received 1 % commission. How much did he receive?

A person who buys or sells goods or transacts business for another is called an **agent**, a **collector**, or a **commission merchant**.

A certain per cent of the amount of money involved in the transaction is called the **commission** or **brokerage**.

A commission merchant gets a certain per cent on the amount of his sales; a collector gets a certain per cent on the amount collected; a broker gets a certain per cent of the cost or the selling price.

If a man buys or sells goods, the amount left after commission and all other charges have been paid is called the **net proceeds**.

The one who sends the merchandise to be sold is the **principal**, the **shipper**, or the **consignor**.

Written Work

NOTE. Count any part of a cent as an additional cent.

1. Mr. Beard sold 60 bbl. apples at \$3.50 a barrel. Find the commission at 10 %.

2. A real estate agent sold four lots for \$250, \$325, \$395, and \$405. How much was his commission at 5 %?

3. A commission merchant sold 320 bbl. apples at \$3.25 a barrel and 16 bbl. at \$4.80 a barrel. Find his commission at 7 %.

4. A lawyer collected an account of \$385 for a client, charging 5 %. How much should he remit ?

5. An agent sold a house for me for \$4250 at 5 % commission. How much money should he remit to me ?

6. Mary was a clerk in a store at a salary of \$12 a week, and 2 % commission. If her average sales were \$300 a week, how much did she earn in a week ?

7. An agent rented a house for \$37.50 a month on 5 % commission. How much did the owner have left at the end of the year, if repairs cost him \$49 a year ?

Find the amount of commission :

PRODUCE	AMOUNT	PRICE	RATE OF COMMISSION	COMMISSION
8. Apples	400 bbl.	\$4.80	10 %	?
9. Raspberries	600 crates	4.20	5 %	?
10. Butter	3050 lb.	.55	5 %	?
11. Peaches	550 bu.	2.50	12½ %	?
12. Eggs	2590 doz.	.58	10 %	?
13. Corn	350 bu.	1.30	5 %	?

14. A Philadelphia commission merchant sold 275 bbl. apples at \$4 a barrel, on a commission of 10 %. The freight was \$67.50 and the drayage was \$11.25. Find the commission and the net proceeds of the sale.

SOLUTION. $275 \times \$4 = \1100 , amount of sale; 10 %, or $\frac{1}{10}$, of \$1100 = \$110, commission. $\$110 + \$67.50 + \$11.25 = \188.75 , total expense. $\$1100 - \$188.75 = \$911.25$, net proceeds.

15. A cotton broker sold 200 bales of cotton of 500 lb. each, @ \$.25, on a commission of 2½ %. Find the net proceeds.

16. My agent bought 180 bbl. apples at \$4.80 a barrel. He paid \$50 freight and \$6 storage. I sent him \$937.28. What was his rate of commission?

17. A fruit grower shipped to his commission merchant 600 bbl. apples, which were sold at \$3.50 a barrel. The agent deducted \$43.90 freight charges, \$27.75 cartage, 12¢ a barrel for cold storage, and 5% commission. Find the amount remitted.

18. James Wilson and Company offered one of their salesmen a salary of \$3000 a year and 2% on all sales over \$40,000; or 8% on all sales if he received no salary. He chose the first offer, and sold \$72,000 worth of goods in the year. Did he gain or lose, and how much, by accepting the first offer?

19. Find the amount of commission, at $2\frac{1}{2}\%$, received by a real estate agent for selling a house and lot for \$3036.

20. I telegraphed my agent at Chicago to buy me 10,000 bu. wheat at \$1.80 or less. He bought at \$1.75 and charged me $\frac{1}{8}\%$ a bushel brokerage. Find the amount of the check I should send him.

21. My broker bought 50,000 lb. cotton at $26\frac{7}{8}\%$ a pound. His commission was $\frac{7}{8}\%$, and freight, storage, and cartage amounted to \$95.80. How much should I remit?

22. A house bought for \$8500 was sold afterwards for 80% of the purchase price. If the agent received 2% on each transaction, find his commission.

23. An agent bought a property for \$36,790 at 2% commission. The owner put \$674.20 in repairs and afterwards sold the property through the same agent for \$43,000, at 2% commission. Find the agent's total commission, and the amount gained by the owner.

SIMPLE INTEREST

Oral Work

1. Mr. Glen pays \$6 for the use of an automobile for half a day. What does he get in exchange for the \$6?

2. Mr. Reed pays \$6 for the right to pasture his cow in a field for a month. What does he get in exchange for the \$6?

3. Mr. Strong pays \$6 for the use of \$100 for one year. What does he get in exchange for the \$6?

Money paid for the use of money is called **interest**.

Thus, in Ex. 3, since Mr. Strong pays \$6 for the use of \$100, the \$6 is *interest*.

The sum on which the interest is paid is called the **principal**.

A certain number of hundredths of the principal paid for the use of the principal for *one year* is called the **rate of interest**.

Time is always a factor in interest. *Interest*, then, is the product of three factors : **principal**, **rate**, and **time**.

In common interest the year is considered as 360 da., and each month is 30 da.

The sum of the principal and the interest is called the **amount**.

4. Mr. Adams borrows \$200 from Mr. Drew for 2 yr. at 6 %. What is the principal? the rate of interest? the time?

5. What part of a year is 1 mo.? 2 mo.? 3 mo.? 4 mo.? 5 mo.? 6 mo.? 7 mo.? 8 mo.? 9 mo.? 10 mo.? 11 mo.? 12 mo.?

6. If the interest for 1 year is \$12, what should it be for 6 months? for 4 months? for 3 months? for 2 months? for 1 month?

7. What is the interest on \$100 at 4 % for 1 year? for $2\frac{1}{2}$ years?

Find the interest on :

- | | |
|--------------------------|---------------------------------------|
| 8. \$300, 1 yr. at 5 % | 18. \$150, $3\frac{1}{2}$ yr. at 6 % |
| 9. \$800, 2 yr. at 6 % | 19. \$700, $4\frac{1}{4}$ yr. at 4 % |
| 10. \$500, 3 yr. at 4 % | 20. \$600, $2\frac{1}{4}$ yr. at 4 % |
| 11. \$400, 4 yr. at 3 % | 21. \$650, $2\frac{1}{2}$ yr. at 6 % |
| 12. \$600, 2 yr. at 5 % | 22. \$800, $3\frac{1}{4}$ yr. at 4 % |
| 13. \$700, 5 yr. at 6 % | 23. \$1000, $2\frac{1}{3}$ yr. at 3 % |
| 14. \$900, 4 yr. at 5 % | 24. \$2000, $2\frac{3}{4}$ yr. at 4 % |
| 15. \$1000, 5 yr. at 4 % | 25. \$3500, $4\frac{1}{3}$ yr. at 3 % |
| 16. \$2000, 3 yr. at 3 % | 26. \$4500, $2\frac{1}{6}$ yr. at 6 % |
| 17. \$3000, 2 yr. at 6 % | 27. \$5000, $3\frac{3}{4}$ yr. at 4 % |

Find the interest on :

- | | |
|--------------------------------------|--------------------------------------|
| 28. \$100, $2\frac{1}{2}$ yr. at 6 % | 37. \$150, $\frac{1}{4}$ yr. at 4 % |
| 29. \$200, $3\frac{1}{2}$ yr. at 4 % | 38. \$800, $2\frac{1}{2}$ yr. at 5 % |
| 30. \$300, $1\frac{1}{2}$ yr. at 6 % | 39. \$200, $\frac{3}{4}$ yr. at 4 % |
| 31. \$200, $\frac{1}{2}$ yr. at 5 % | 40. \$100, $2\frac{2}{3}$ yr. at 3 % |
| 32. \$400, $1\frac{3}{4}$ yr. at 4 % | 41. \$900, $1\frac{3}{4}$ yr. at 4 % |
| 33. \$800, $2\frac{3}{4}$ yr. at 4 % | 42. \$800, $1\frac{1}{2}$ yr. at 4 % |
| 34. \$900, $1\frac{1}{3}$ yr. at 6 % | 43. \$600, $2\frac{1}{3}$ yr. at 3 % |
| 35. \$100, $2\frac{1}{8}$ yr. at 6 % | 44. \$500, $1\frac{1}{6}$ yr. at 6 % |
| 36. \$200, $3\frac{1}{4}$ yr. at 4 % | 45. \$100, $3\frac{1}{2}$ yr. at 4 % |

46. Find the yearly interest at $3\frac{1}{2}$ % on a \$1000 bond of the First Liberty Loan.

47. The Second Liberty Loan bonds run for 15 yr. At 4 %, how much interest will a \$100 bond earn in that time?

48. What is the yearly interest at $4\frac{1}{4}$ % on a \$1000 bond of the Third Liberty Loan?

49. How much interest at $4\frac{1}{4}$ % will be earned in a year on a \$100 bond of the Fourth Liberty Loan?

How to find the interest for years and months.

Written Work

1. What is the interest on \$400 for 3 yr. 6 mo. at 6 %?

\$400, principal

.06, rate

\$24.00, interest for 1 yr.

 $3\frac{1}{2}$

\$84.00, interest for 3 yr. 6 mo.

The interest for 1 yr. is .06 of the principal, or \$24. The interest for 3 yr. 6 mo., or $3\frac{1}{2}$ yr., is $3\frac{1}{2} \times \$24$, or \$84.

$$\text{Or, } \frac{6}{100} \times \frac{7}{2} \times \frac{2}{100} \times \$400 = \$84.$$

Multiply the principal by the rate and the product by the number of years.

If we represent principal, interest, rate, and time by their initials, we have the following formula :

FORMULA : $i = t \times r \times p$.

SOLUTION OF EX. 1 BY FORMULA : $i = t \times r \times p = 3\frac{1}{2} \times .06 \times \$400 = \$84$.

The year is usually considered as 360 days, that is, 12 months of 30 days each.

Find the interest on :

- | | |
|------------------------------------|-------------------------------------|
| 2. \$250, 1 yr. 6 mo., 4 % | 14. \$960, 9 mo., 6 % |
| 3. \$700, 2 yr. 4 mo., 6 % | 15. \$900, $2\frac{3}{4}$ yr., 7 % |
| 4. \$100, 3 yr. 8 mo., 6 % | 16. \$654, $\frac{3}{4}$ yr., 6 % |
| 5. \$80, 4 yr. 6 mo., 5 % | 17. \$220, $\frac{7}{8}$ yr., 8 % |
| 6. \$40, 2 yr. 8 mo., 6 % | 18. \$150, $4\frac{1}{2}$ yr., 5 % |
| 7. \$216, 1 yr. 1 mo., 4 % | 19. \$190, $2\frac{1}{2}$ yr., 6 % |
| 8. \$950, 2 yr. 3 mo., 8 % | 20. \$600, $2\frac{1}{3}$ yr., 4 % |
| 9. \$150, 3 yr. 2 mo., 4 % | 21. \$800, 9 mo., 6 % |
| 10. \$740, 4 yr. 4 mo., 4 % | 22. \$940, $2\frac{3}{4}$ yr., 7 % |
| 11. \$150, $1\frac{1}{2}$ yr., 4 % | 23. \$650, $\frac{3}{4}$ yr., 6 % |
| 12. \$96, 2 yr. 6 mo., 8 % | 24. \$225, $\frac{1}{4}$ yr., 8 % |
| 13. \$75, $3\frac{3}{4}$ yr., 7 % | 25. \$3500, $3\frac{1}{2}$ yr., 6 % |

26. Find the amount necessary to pay a loan of \$1500 at 6% from Feb. 1, 1919 to April 1, 1920.

SOLUTION. The time is 1 yr. 2 mo. or $1\frac{1}{3}$ yr. Int. on \$1500 for $1\frac{1}{3}$ yr. at 6% = \$105. Amount = \$1500 + \$105, or \$1605.

Find the interest and the amount of:

27. \$660 at 6% for 1 yr. 2 mo.

28. \$457.75 at 6% for 2 yr. 8 mo.

29. \$675 at 6% for 1 yr. 4 mo.

30. \$1200 at 6% for 2 yr. 8 mo.

31. \$84.50 at 6% for 3 yr. 3 mo.

32. \$90.75 at 6% for 2 yr. 6 mo.

33. \$530 at 5% for 3 yr. 6 mo.

34. \$150 at 4% for 4 yr. 1 mo.

35. \$275 at 6% for 1 yr. 10 mo.

36. \$120 at 5% for 2 yr. 8 mo.

37. \$625 at 4% for 8 mo.

38. \$400 at 6% for 3 yr. 7 mo.

39. \$275 at 5% for 2 yr. 11 mo.

40. \$50 at $4\frac{1}{4}$ % for 6 mo.

41. \$500 at 6% for 4 mo.

42. \$150 at 4% for 2 yr. 2 mo.

43. \$624 at 3% for 120 da.

44. Find the amount necessary to pay a loan of \$250 at 6% from Jan. 4, 1919 to March 4, 1920.

45. Find the interest at 6% on \$375, borrowed Sept. 2, 1918, and paid March 2, 1920.

46. Thomas borrowed \$250 to help him through college. Find the amount he must pay at the end of 3 yr. 6 mo., at 6% interest.

How to find the interest for years, months, and days.

Written Work

1. Find the interest and the amount of \$960 for 3 yr. 7 mo. 18 da. at 5%.

\$960, principal

.05, rate

\$48.00, int. for 1 yr.

\$960 + \$174.40 = \$1134.40, amount.

$$7 \text{ mo.} = \frac{7}{12} \text{ yr.}; 18 \text{ da.} = \frac{18}{360} \text{ yr., or } \frac{1}{20} \text{ yr.}$$

$$\text{Total time} = 3\frac{19}{20} \text{ yr.}$$

$$3\frac{19}{20} \times \$48 = \$174.40, \text{ int. for } 3\frac{19}{20} \text{ yr.}$$

Or,

\$960, principal

.05, rate

\$48.00, int. for 1 yr.

$$3 \times \$48 = \$144.00, \text{ int. for 3 yr.}$$

$$\frac{1}{2} \text{ of } \$48 = 24.00, \text{ int. for } 6 \text{ mo.}$$

$$\frac{1}{12} \text{ of } \$48 = 4.00, \text{ int. for } 1 \text{ mo.}$$

$$\frac{1}{2} \text{ of } \$4.00 = 2.00, \text{ int. for } 15 \text{ da.}$$

$$\frac{1}{10} \text{ of } \$4.00 = .40, \text{ int. for } 3 \text{ da.}$$

\$174.40, int. for 3 yr. 7 mo. 18 da.

960.00, principal

\$1134.40, amount

Find the interest and the amount on the following at 6% ; at 4% ; at $4\frac{1}{2}\%$; at $5\frac{1}{2}\%$.

- | | |
|---------------------------|---------------------------------|
| 2. \$500 for 6 mo. 15 da. | 9. \$25.50 for 3 mo. 29 da. |
| 3. \$250 for 8 mo. 20 da. | 10. \$175.50 for 105 da. |
| 4. \$360 for 5 mo. 10 da. | 11. \$150 for 9 mo. 12 da. |
| 5. \$475 for 90 da. | 12. \$387.50 for 6 mo. 25 da. |
| 6. \$900 for 6 mo. 25 da. | 13. \$125.50 for 10 mo. 21 da. |
| 7. \$125 for 4 mo. 19 da. | 14. \$345.50 for 6 mo. 15 da. |
| 8. \$325 for 6 mo. 23 da. | 15. \$755 for 1 yr. 9 mo. 6 da. |

How to find interest by the one dollar 6% method.

Written Work

The interest at 6% on \$1 for 30 da. (1 mo.) = \$.005.

The interest at 6% on \$1 for 1 da. ($\frac{1}{30}$ of \$.005) = \$.000 $\frac{1}{3}$.

1. What is the interest on \$240.60 for 2 yr. 3 mo. 13 da. at 6%? at 4%?

2 yr. 3 mo. = 27 mo.

\$.135, interest on \$1 at 6% for 27 mo. $240.60 \times \$.137\frac{1}{6} = \33.00 ,

.002 $\frac{1}{3}$, interest on \$1 at 6% for 13 da. interest on \$240.60 at 6%

\$.137 $\frac{1}{6}$, interest on \$1 at 6% for 2 yr. 3 mo. 13 da. $4\% = \frac{2}{3}$ of 6% ; $\frac{2}{3}$ of \$33 = \$22, interest on \$240.60 at 4%.

Change the time to months and days. Since the interest on \$1 for 1 mo. is $\frac{1}{2}$ of a cent and for 1 da. $\frac{1}{3}$ of a mill, the interest on one dollar will be $\frac{1}{2}$ as many cents as there are months and $\frac{1}{3}$ as many mills as there are days. Multiply the result by a number equal to the number of dollars in the principal.

Find the interest on the following at 6% ; at 4% ; at 5%.

- | | |
|-----------------------|-----------------------------|
| 2. \$7450 for 93 da. | 13. \$8790 for 5 mo. |
| 3. \$8400 for 65 da. | 14. \$8250 for 6 mo. |
| 4. \$9800 for 40 da. | 15. \$150 for 3 mo. 6 da. |
| 5. \$8440 for 72 da. | 16. \$180 for 5 mo. 9 da. |
| 6. \$5500 for 5 da. | 17. \$195 for 6 mo. 10 da. |
| 7. \$6750 for 8 da. | 18. \$250 for 8 mo. 12 da. |
| 8. \$4765 for 25 da. | 19. \$340 for 2 yr. 4 mo. |
| 9. \$6245 for 110 da. | 20. \$275 for 3 yr. 8 mo. |
| 10. \$8425 for 52 da. | 21. \$450 for 1 yr. 5 mo. |
| 11. \$5150 for 3 mo. | 22. \$675 for 3 yr. 7 mo. |
| 12. \$8465 for 4 mo. | 23. \$64.60 for 2 yr. 9 mo. |

How to find the interest by the sixty-day 6 % method.

Since 60 da. or 2 mo. = $\frac{1}{6}$ yr. and $\frac{1}{6}$ of 6 % = 1 %, *the interest on any sum for 60 da. at 6 % = 1 % of the principal.*

NOTE. The interest for 30 da. = $\frac{1}{2}$ the interest for 60 da.; the interest for 90 da. = $\frac{3}{2}$ the interest for 60 da. etc. The interest at 5 % = $\frac{5}{6}$ the interest at 6 %; at 4 %, $\frac{2}{3}$ the interest at 6 %, etc.

Written Work

1. Find the interest on \$3600 for 90 da. at 5 %.

$$6 \% \text{ int. for 60 da. on } \$3600 = \$36.00$$

$$5 \% \text{ int. for 90 da. on } \$3600 = \frac{5}{6} \text{ of } \frac{3}{2} \text{ of } \$36 = \$45$$

Find the interest on the following at 6 %; at 4 %; at 5 %.

- | | |
|----------------------------|----------------------------|
| 2. \$200 for 60 da. | 19. \$475 for 90 da. |
| 3. \$190 for 30 da. | 20. \$900 for 6 mo. 20 da. |
| 4. \$320 for 90 da. | 21. \$135 for 4 mo. 20 da. |
| 5. \$500 for 60 da. | 22. \$325 for 60 da. |
| 6. \$700 for 90 da. | 23. \$805 for 75 da. |
| 7. \$800 for 15 da. | 24. \$425 for 2½ mo. |
| 8. \$900 for 10 da. | 25. \$500 for 30 da. |
| 9. \$700 for 60 da. | 26. \$280 for 45 da. |
| 10. \$600 for 20 da. | 27. \$345 for 1 yr. 6 mo. |
| 11. \$562 for 16 mo. | 28. \$850 for 1 yr. 2 mo. |
| 12. \$335 for 8 mo. | 29. \$392 for 1 yr. 4 mo. |
| 13. \$222 for 9 mo. | 30. \$362 for 1 yr. 2 mo. |
| 14. \$375 for 1 yr. 4 mo. | 31. \$563 for 60 da. |
| 15. \$387 for 1 yr. 6 mo. | 32. \$147 for 30 da. |
| 16. \$500 for 6 mo. 15 da. | 33. \$150 for 90 da. |
| 17. \$250 for 8 mo. 20 da. | 34. \$650 for 120 da. |
| 18. \$360 for 5 mo. 10 da. | 35. \$160 for 100 da. |

Find the interest by the most convenient method :

	PRIN.	TIME	RATE		PRIN.	TIME	RATE
36.	\$350	105 da.	4%	39.	\$129	23 mo.	5%
37.	\$685	4 mo.	4½%	40.	\$750	13 mo.	5%
38.	\$850	87 da.	6%	41.	\$492	97 da.	3½%
42.	At 5% on \$237.50 from Jan. 3, 1918 to Sept. 11, 1920.						

NOTE. Find the difference in time by subtraction of 1918 yr. 1 mo. 3 da. from 1920 yr. 9 mo. 11 da., regarding each month as made up of 30 da.

43. At 6% on \$309.75 from May 7, 1917 to Jan. 14, 1919.
 44. At 5½% on \$7500 from June 12, 1917 to Nov. 1, 1918.
 45. At 4½% on \$750 from Feb. 14, 1916 to Aug. 11, 1920.
 46. At 5% on \$2900 from July 3, 1916 to May 12, 1920.
 47. At 4% on \$3675 from June 4, 1917 to April 1, 1920.
 48. At 6% on \$5000 for 2 yr. 3 mo. 6 da.

Sometimes the exact number of days is taken between the dates and 365 days are counted to the year. This is called **exact interest**.

49. What is the exact interest at 6% on \$1000 from April 5, 1918 to Feb. 4, 1919?

SOLUTION. The time is 305 da. (April, 25 da.; May, 31 da.; June, 30 da.; July, 31 da.; Aug., 31 da.; Sept., 30 da.; Oct., 31 da.; Nov., 30 da.; Dec., 31 da.; Jan., 31 da.; Feb., 4 da.)

Interest for 1 yr. = 6% of \$1000 = \$60. Exact int. for 305 da. = $\frac{305}{365}$ of \$60 = \$50.14. (See also p. 317.)

50. Find the exact interest of \$4780 from April 1, 1920 to Sept. 18, 1920, at 6½%.

51. On September 16, 1918, I borrowed \$3600 at 5%. How much will settle the loan April 1, 1919, with exact interest?

52. Mr. Hoyt borrowed \$5400 for 110 da. at 6%. Find the exact interest due.

PROBLEMS IN SIMPLE INTEREST

NOTE. Pages 69 and 70 may be deferred if the teacher thinks best.

How to find the principal.

Written Work

1. What principal invested at 4 % per annum will yield \$200 interest a year ?

SOLUTION. Since the interest on \$1 for 1 yr. at 4 % is \$.04, as many dollars must be invested to yield \$200 a year as \$.04 is contained times in \$200. $\$200 \div \$.04 = 5000$. Hence \$5000 must be invested.

The principal equals the given interest divided by the interest on \$1 for the given time at the given rate.

Since $i = t \times r \times p$,

FORMULA: $p = i \div (t \times r)$.

SOLUTION OF EX. 1 BY FORMULA: $p = i \div (t \times r) = \$200 \div (1 \times .04) = \5000 .

2. What principal at 5 % will gain \$100 interest in 2 yr.?
3. What principal at 6 % will gain \$180 interest in $1\frac{1}{2}$ yr.?
4. What principal at 3 % will gain \$15 interest in 6 mo.?

How to find the rate.

Written Work

1. At what rate must \$500 be invested to yield \$75 interest in 2 yr. 6 mo. ?

SOLUTION. Since the interest on \$500 for $2\frac{1}{2}$ yr. at 1 % is \$12.50, it will require a rate of as many per cent to yield \$75 as \$12.50 is contained times in \$75, or 6 %.

The rate equals the given interest divided by the interest for the given time at 1 %.

Since $i = t \times r \times p$,

FORMULA: $r = i \div (t \times p)$.

SOLUTION OF EX. 1 BY FORMULA: $r = i \div (t \times p) = \$75 \div (2\frac{1}{2} \times \$500) = .06$, or 6 %.

2. At what rate will \$1000 earn \$120 interest in 2 yr.?
3. At what rate will \$500 earn \$75 interest in 3 yr.?
4. The interest on \$1120 for $3\frac{1}{2}$ yr. is \$156.80. What is the rate?
5. At what rate will \$3000 earn \$510 in $4\frac{1}{4}$ yr.?
6. At what rate will \$1800 yield \$225 interest in $2\frac{1}{2}$ yr.?
7. At what rate will \$2000 yield \$400 interest in 4 yr.?
8. At what rate will \$50 yield \$2 interest in 6 mo.?

How to find the time.

Written Work

1. In what time will \$450 at 6% yield \$90 interest?

SOLUTION. Since the interest on \$450 for 1 yr. at 6% is \$27, the required time is as many years as \$27 is contained times in \$90, or $3\frac{1}{3}$ yr.

The time in years equals the given interest divided by the interest at the given rate for 1 year.

Since $i = t \times r \times p$,

FORMULA: $t = i \div (r \times p)$.

SOLUTION OF EX. 1 BY FORMULA: $t = i \div (r \times p) = \$90 \div (.06 \times \$450) = 3\frac{1}{3}$ yr.

2. In what time will \$1000 gain \$120 interest at 6%?
3. In what time will \$500 gain \$75 interest at 5%?
4. In what time will \$650 gain \$104 interest at 4%?
5. In what time will \$275 gain \$55 interest at 6%?
6. In what time will any principal double itself (that is, gain 100% of itself) at 5%? at 6%? at 8%?
7. In what time will any principal treble itself (that is, gain 200% of itself) at 5%? at 6%? In what time will it quadruple itself at 8%? at 10%?
8. In what time will \$500 at 5% yield \$63.75 interest?
9. In what time will \$50 at 4% yield \$2 interest?



EVERYDAY USE OF NUMBERS

Problems about Cooking

NOTE. Teachers should use their judgment about assigning to boys problems about cooking, sewing, etc., which are usually of greater interest to girls.

Equivalents. 3 teaspoonfuls (tsp.) = 1 tablespoonful (tbsp.).

4 tablespoonfuls = $\frac{1}{4}$ cup (c.), or $\frac{1}{2}$ gill.

2 gills = 1 cup.

2 cups solid meat = 1 pound.

2 cups = 1 pint.

2 tablespoonfuls sugar = 1 ounce.

4 cups flour = 1 pound.

2 tablespoonfuls flour = 1 ounce.

2 cups solid butter = 1 pound.

2 tablespoonfuls liquid = 1 ounce.

3 cups meal = 1 pound.

2 cups granulated sugar = 1 pound.

1. How many cups of milk do $2\frac{1}{2}$ qt. make?
2. How many cups of butter does $\frac{3}{4}$ lb. make?
3. How many tablespoonfuls of flour do 2 lb. make?
4. What part of a pound of flour do 3 cups make?
5. What part of a pound of sugar is a tablespoonful?
6. What part of a pound of sugar is half a cup?

A class of 20 girls used the following supplies:

7. Each girl used 3 teaspoonfuls of sugar. How much was used by the class? What was the cost at 10 ¢ a pound?
8. Each girl used 4 tablespoonfuls of butter. How much was used by the class? Find the cost at 60 ¢ a pound.
9. At 2 ¢ each, find the cost of milk for the class.
10. At 3 ¢ each, find the cost of flour for the class.

11. At $\frac{1}{3}$ ¢ each, find the cost of meal for the class.
12. Each girl used $4\frac{1}{2}$ ¢ worth of meat. Find the cost.
13. Each girl used 2 tablespoonfuls of vinegar. How much was used by the class? What was the cost at 10 ¢ a quart?
14. Allowing 86 ¢ for other materials used by this class, calculate the total sum for the lesson; the cost per person.
15. If $\frac{3}{4}$ of a cup of corn could be cut from 3 ears of green corn, how many ears would be required to get 4 cups?
16. Fine hominy requires 4 parts water to 1 part hominy. How much water should be used with $\frac{1}{3}$ cup of fine hominy?
17. A receipt called for 1 part coarse hominy and 5 parts cold water. How much coarse hominy should be used with $2\frac{1}{2}$ cups of water?
18. One year Mrs. Dunn earned \$50 by raising and canning vegetables; the next year, by better methods of farming, she earned \$100; and the third year, by increasing her efforts, she earned \$300. What per cent of the first year's earnings were the second year's? the third year's? What per cent of the second year's earnings were the third year's?
19. The cost for a cooking laboratory equipment in a public elementary school was \$1200. In taking the inventory at the close of the school year, 5 % was allowed for general depreciation. What was the amount of the depreciation?
20. If a receipt for Chili sauce called for 1 bu. of tomatoes, 5 qt. of onions, 12 green peppers, 1 cup of salt, 1 cup of sugar, $\frac{1}{2}$ cup of cinnamon, and 3 qt. of vinegar, what proportions should you use with 8 qt. of tomatoes?
21. If 2 cups of flour, 4 tablespoonfuls of baking powder, 1 teaspoonful of salt, 1 tablespoonful of lard, $\frac{3}{4}$ cup of milk, and 1 tablespoonful of butter make 12 biscuits, how much should you use to make 30 biscuits?

22. If a housekeeper used 2 cups of flour for biscuits, $2\frac{1}{2}$ cups for a cake, $1\frac{1}{2}$ cups for a pie, and 3 qt. for bread, what part of a 25-pound bag did she have left? (See p. 71.)

23. Given the following receipt for ice cream: 1 qt. of milk, 1 cup of sugar, 1 cup of cream. If milk is 14¢ a quart, cream 60¢ a quart, and sugar 9¢ a pound, what would be the cost of the ice cream, allowing 10¢ for ice and salt for freezing?

24. The above receipt will serve 10 people. How much of each ingredient must be used to serve 35 people?

25. If a loaf of bread contains $\frac{3}{4}$ lb. of flour, 20% of which is wheat flour and the rest rye flour, how much of each kind of flour is there in the loaf of bread?

26. A domestic science teacher explained how good beef fat could be rendered and used for cooking, in place of butter, in many cases. There were 60 families represented in these cooking classes. In giving their monthly reports for home work, it was found that the community had used 100 lb. of the beef drippings for cooking purposes, instead of an equal amount of butter. Compute the cost of these beef drippings selling at 30 cents a pound, and the total saving, when butter is 50 cents a pound.

27. Mary was told to use $\frac{1}{4}$ cup tapioca, $\frac{1}{2}$ cup water, and 1 cup milk for porridge. With the same proportions, how much tapioca would she have to use with $2\frac{1}{2}$ cups of milk?

28. Twelve cents per capita for each lesson was the amount allowed for cost of maintenance in an elementary school kitchen laboratory. Four classes reported for work. The classes contained 20, 25, 15, and 10 pupils, respectively. These classes reported once a week for 36 weeks. How much did it cost to maintain the running expenses of the cooking classes?

The following receipts were issued by the United States Food Administration :

MUFFINS

1 cup barley flour 1 cup milk
 $\frac{1}{2}$ cup corn flour 1 egg
 $\frac{1}{2}$ teaspoon salt
 1 tablespoon sugar
 2 tablespoons fat
 4 teaspoons baking powder

BEEF STEW

1 pound beef
 4 potatoes cut in quarters
 $\frac{1}{2}$ peck peas
 $\frac{1}{2}$ cup carrots cut up small
 1 teaspoon salt

29. The first receipt will make 12 muffins. Change it to the proper quantities for 9 muffins; for 18 muffins.

30. Find the cost of the beef stew, with beef at 30 ¢ a pound, peas at 15 ¢ a quart, 5 ¢ for a cup of carrots, and potatoes at 4 ¢ a pound, each potato weighing 3 oz.

POTATO CORN MEAL ROLLS (12 ROLLS)

Mashed potatoes, 1 cup	Milk, 2 tablespoons
Corn meal, 1 cup	Fat, 2 tablespoons
Barley flour, $\frac{1}{2}$ cup	Egg, 1
Baking powder, 4 teaspoons	Salt, 1 teaspoon

31. Change the above receipt to make 30 rolls.

CORN PUDDING

1 cup canned or grated fresh corn	1 egg
$1\frac{1}{2}$ cups milk	$\frac{1}{2}$ cup bread crumbs
1 teaspoon lemon juice	2 tablespoons grated cheese
1 tablespoon butter	Salt, paprika

32. If you use only 1 cup of milk in the above receipt, how should you reduce the other ingredients?

SUGGESTION. 1 cup is $\frac{2}{3}$ of $1\frac{1}{2}$ cups.

FISH PIE (5 SERVINGS)

Mashed potatoes, 2 cups	Onions, chopped, 2 tablespoons
Cooked flaked fish, 2 cups	Green pepper, $\frac{1}{2}$
Canned tomatoes, $1\frac{1}{4}$ cups	Salt, $\frac{1}{2}$ teaspoon
Fat, 1 tablespoon	Paprika, $\frac{1}{2}$ teaspoon
Barley flour, 1 tablespoon	

33. Change this receipt to make enough for a family of 8.

POTATO SPOON BREAD (8 SERVINGS)

Mashed potatoes, $\frac{1}{2}$ cup	Eggs, 2
Corn meal, $\frac{1}{2}$ cup	Milk, $\frac{1}{2}$ cup
Water, $1\frac{1}{2}$ cups	Salt, 2 teaspoons
Fat, 1 tablespoon	

34. Change this receipt to make enough for 12 servings.

POTATO BALLS (4 SERVINGS)

Potatoes, small, 5	Salt, $\frac{1}{2}$ teaspoon
Egg yolk, 1	Pepper, $\frac{1}{2}$ teaspoon
Fat or olive oil, $1\frac{1}{2}$ tablespoons	Cheese, grated, $\frac{1}{2}$ cup
Parsley, chopped, 3 teaspoons	Egg, $\frac{1}{2}$, for dipping
Corn meal, $\frac{1}{2}$ cup (for crumbing)	

35. Change this receipt to make enough for 6 servings.

ANALYSES AND FOOD VALUES

KIND	WATER	DRY FLESH	PROTEIN	FAT	ASH
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Sirloin steak	60.00	40.00	20.00	19.00	1.00
Mutton, leg	61.80	38.20	18.30	19.00	.90
Salmon, fresh	63.60	36.40	21.60	13.40	1.40
Mackerel	64.01	28.88	18.77	8.21	1.40

Find the amount of dry flesh, protein, and fat in:

- | | |
|---------------------------------------|---------------------------------------|
| 36. 5 lb. sirloin steak. | 39. $3\frac{3}{4}$ lb. mackerel. |
| 37. $4\frac{1}{2}$ lb. leg of mutton. | 40. $3\frac{1}{2}$ lb. sirloin steak. |
| 38. 3 lb. fresh salmon. | 41. $4\frac{1}{2}$ lb. mackerel. |

Find, to the nearest tenth per cent, the per cent of increase or decrease in the prices of each of the following articles from 1917 to 1918.

PER POUND	1917	1918	PER POUND	1917	1918
42. Sirloin steak .	\$.33	\$.42	49. Butter . . .	\$.46	\$.55
43. Rib roast . . .	.26	.33	50. Rice . . .	.11	.13
44. Bacon . . . .	.43	.52	51. Potatoes . .	.043	.039
45. Ham . . . .	.40	.49	52. Beans . . .	.15	.17
46. Lamb . . . .	.30	.37	53. Tea . . . .	.60	.65
47. Lard . . . .	.27	.33	54. Eggs, per doz.	.42	.49
48. Flour . . . .	.072	.067	55. Milk, per qt. .	.11	.14

Problems about Sewing



1. The material for a ruffle was 12 in. deep. The ruffle had a 1-in. hem, with $\frac{1}{8}$ in. for first turn over, and 5 quarter-inch tucks. How wide was the ruffle when finished?

2. It took $2\frac{1}{2}$ yd. of material for a girl's waist. How many waists could be cut from a piece of lawn measuring $17\frac{1}{2}$ yd.? If the lawn cost 15 ¢ a yard, what was the cost per waist?

3. Edith covered two cushions, one 27 in. and the other 21 in. long. The covers required twice the length of the cushions, plus 1 in. for seams, and the narrow pieces for the edge. The material was wide enough to allow for these small strips. The price per yard was 50 ¢. How much did the material cost?

4. It required $1\frac{1}{2}$ times the width of a skirt for a full ruffle. What was the length of a ruffle for a skirt measuring $2\frac{1}{2}$ yards around, allowing 4 in. for seams?

5. How much material was taken up by a $\frac{1}{2}$ -inch hem with $\frac{1}{8}$ inch for first turn over and six $\frac{1}{8}$ -inch tucks?

6. A ruffle was to be finished with a 1-inch hem. Allowing $\frac{1}{4}$ inch for the first turn over and $\frac{1}{4}$ inch for the gathering, how deep must the ruffle be cut to finish 7 inches?

7. A piece of lawn 27 in. wide was tacked. When finished, it was 15 in. wide. How many $\frac{1}{8}$ -inch tucks were made?

8. It required $1\frac{3}{4}$ yd. of material to cut a child's dress. How many dresses could be cut from $14\frac{1}{2}$ yd.? The material cost 10 ¢ a yard. What was the cost of each dress?

9. Constance made a scarf 45 in. long and 8 in. wide when finished. How long did it take her to hemstitch it, at an average of $9\frac{1}{4}$ in. an hour? (Draw a diagram.)

10. Towels having $\frac{3}{4}$ -inch hems at the top and bottom were 30 in. long when finished. How many towels could be made from 7 yd. ?

11. How much toweling was needed for a class of 20 to give each pupil a towel to hem like those described in Ex. 10 ?

12. How many yards of cheesecloth were needed to make dust cloths $18'' \times 18''$, for a class of 16, if the material was 1 yd. wide ?

Household Thrift

1. If soap is left unwrapped in a dry place, it loses at least 25 % of the moisture which it contains, and the same amount of soap becomes 25 % more efficient. On this basis, find the saving on soap costing \$7.50 which had been thoroughly dried before using.

2. Mrs. Drake found that she saved 60 % on her fuel bills by combining different processes of cooking and laundry work at a given time. At this rate how much was saved for each \$8 formerly spent for fuel ?

3. If her fuel bill before the saving was \$130 a year, how much did she save per year by her economy ?

4. Mrs. Thorne purchased 2 tablecloths at a sale. The regular price for the cloths was \$8 each. The sale price was 25 % off the regular price. The tablecloths were in daily service for 18 months and were then unfit for use. How much did the tablecloths cost per month ?

5. Mrs. Noble bought 2 tablecloths at the same sale. She selected a good strong linen. The regular price for these cloths was \$10 each, and the discount was 25 %. These cloths were in constant use for 36 months. How much did they cost per month ?

6. Mrs. May required 4 yd. of serge for her daughter's dress. The regular cost of the material was \$2 a yard. She found three remnants containing the required number of yards. The remnants were of such lengths that each one could be used to advantage, one for sleeves, one for waist, and the third for the skirt of the dress. Mrs. May got the three remnants for \$5.75. What per cent did she save on the regular price basis?

7. Mrs. Grant, who needed 4 yd. of serge for a dress, bought 4 remnants amounting to $4\frac{1}{4}$ yd. for \$6.25; but finding that the remnants would not give the skirt lengths for the pattern, she was obliged to buy 1 additional yard of serge at \$2. How much more did she pay for her material than if she had bought the 4 yards at \$2 a yard?

8. Susan bought a \$15 coat for \$10; John, an \$18 overcoat for \$15; Henry an \$18 suit for \$13.75. Find the per cent of discount each one received.

9. Mr. Burton bought 50 cwt. of hard coal and 25 cwt. of soft coal. The hard coal cost \$9 a ton and the soft coal cost \$6 a ton. Write the dealer's receipt for the bill if a discount of 2% for cash was given.

10. Mrs. Smith got the August sale discounts in furniture and carpets: 1 library rug \$75, 25% off; 1 reading table \$32, $16\frac{2}{3}$ % off; 4 library chairs \$24, less 20%; and a Roman reading chair \$12, less $33\frac{1}{3}$ %. Make out the bill.

11. Mrs. Rodman went shopping with her daughter. She bought 1 muff \$40, less 30%; 1 suit \$25, less 25%; 1 coat \$20, less 30%; 1 fur neckpiece \$35, less 40%. Find the total amount of the bill.

12. When flour was sold for \$10.50 a barrel (196 lb.), how much cheaper was it to buy 196 lb. by the barrel than at 7¢ a pound?

13. Mrs. Bronson's bill for the week from a department store was as follows: $12\frac{1}{2}$ yd. gingham @ 45¢; 3 chairs @ \$2.25; 1 coat \$12, 3 lb. coffee @ 32¢, and 1 pair of slippers \$2.75. Cash discount 5%. Find the total bill, if cash was paid.

14. A delivery boy had in his wagon for Mrs. Arnold, 2 lb. beans @ \$.12; $3\frac{3}{4}$ lb. butter @ 40¢; 3 cans tomatoes @ 15¢; 5 bunches beets @ 5¢; 6 lb. corn meal @ 5¢; and 15 lb. beans @ 8¢. Find the total amount of her bill.

15. Find the amount of the following deliveries of soft coal at \$6.80 a ton: 15 cwt.; 2950 lb.; 1800 lb.; 3900 lb.; 1 T. 9 cwt.; 6 cwt.; 950 lb.; 1400 lb.; 6000 lb.; 5450 lb., 2950 lb.

16. The cost of clothing for Mr. Orr's family for three months was as follows: dressmaking 8 days at \$3.00 a day; 1 overcoat \$50, less 25%; 1 suit for \$30, less 30%; 15 yd. dress goods at \$1.75 a yard; miscellaneous items for dressmaker \$4.75; 1 hat \$12, less 30%. Find the total cost.

17. Mrs. Burke received a bill of \$1500 for furnishing a house. She was allowed a discount of 5% for cash, or $2\frac{1}{2}$ % for payment in one month. How much did she save by paying cash? by paying in one month?

18. Mrs. Clark, who had been paying \$50 a month rent for her house, bought it for \$6000. Taxes, insurance, and repairs cost her \$120 a year and interest 6% on the investment. How much a year did she save by purchasing the house?

19. Mr. Bent bought a house for \$4700 and leased it to Mr. Owen for \$40 a month. If he paid on an average \$198 a year for insurance, taxes, and repairs, what per cent of the investment did he receive on the property?

PROBLEMS WITHOUT NUMBERS

1. If you know how many problems there are in an examination and what per cent John has right, how can you tell how many problems he has right?

2. If your father tells you how much he paid for a cow and how much he sold it for, how can you find the gain or the loss? How can you find the per cent gained or lost?

3. How can you express a certain per cent of a number as a common fraction? as a decimal fraction?

4. How can you find what per cent one number is of another?

5. How can you find a number when a per cent of it is given?

6. A store advertises all its goods on a certain date at a reduction of a certain per cent from the former prices, which are stated. How can you find the reduced price of each article?

7. If you know what per cents you had in each of a given number of examinations, how can you find your average?

8. A teacher is allowed a certain discount on the catalogue prices of books. How can she find how much each book will cost her?

9. How can you find a single discount that is equal to two successive trade discounts?

10. If you know the list price of an automobile and the trade and cash discounts, how can you tell the net cash price?

11. If you know how long a sum of money has been lent, and the rate of interest, how can you find the interest?

TESTS FOR ACCURACY AND SPEED

NOTE. In such exercises the pupils may occasionally "run number races," to see how many correct answers each pupil can get in a given time. Establish a class standard and let each pupil drill until he has reached it.

Add and test:

- | | | |
|---|---|---|
| 1. 879,521
363,310
450,816
248,009
737,527
<hr style="width: 100%;"/> | 2. 678,095
923,898
897,075
489,367
238,409
<hr style="width: 100%;"/> | 3. \$8739.56
7328.49
6434.87
9163.48
5092.64
<hr style="width: 100%;"/> |
| 4. $29\frac{5}{16}$
$42\frac{3}{4}$
<hr style="width: 100%;"/> | 5. $129\frac{7}{10}$
$347\frac{4}{16}$
<hr style="width: 100%;"/> | 6. $387\frac{5}{8}$
$460\frac{3}{8}$
<hr style="width: 100%;"/> |
| 7. $308\frac{3}{4}$
$216\frac{3}{8}$
791
<hr style="width: 100%;"/> | 8. $23\frac{3}{8}$
$36\frac{8}{10}$
$19\frac{4}{16}$
<hr style="width: 100%;"/> | 9. $226\frac{1}{2}$
$439\frac{3}{8}$
$614\frac{3}{16}$
<hr style="width: 100%;"/> |
| 10. 18.7396
23.7849
6.0707
65.8698
<hr style="width: 100%;"/> | 11. 52.09
341.807
49.756
850.675
<hr style="width: 100%;"/> | 12. 90.0878
573.219
665.238
695.0087
<hr style="width: 100%;"/> |
| 13. 7.0358
29.9046
38.02
47.5375
56.7402
<hr style="width: 100%;"/> | 14. 318.07
25.0626
384.9857
4167.636
263.158
<hr style="width: 100%;"/> | 15. 758.0309
23.456
3543.47
4067.8012
5678.9543
<hr style="width: 100%;"/> |
| 16. 4 yd. 6 in.
6 yd. 9 in.
<hr style="width: 100%;"/> | 19. 8 pk. 3 qt.
7 pk. 6 qt.
<hr style="width: 100%;"/> | 22. 5 mi. 200 rd.
4 mi. 300 rd.
<hr style="width: 100%;"/> |
| 17. 3 ft. 4 in.
5 ft. 9 in.
<hr style="width: 100%;"/> | 20. 8 yd. 1 ft.
3 yd. 2 ft.
<hr style="width: 100%;"/> | 23. 6 doz. 6
3 doz. 10
<hr style="width: 100%;"/> |
| 18. 15 min. 3 sec.
10 min. 2 sec.
<hr style="width: 100%;"/> | 21. 7 lb. 3 oz.
5 lb. 8 oz.
<hr style="width: 100%;"/> | 24. 3 yr. 2 mo.
2 yr. 10 mo.
<hr style="width: 100%;"/> |

Subtract and test :

- | | | |
|--|---|--|
| 25. $\begin{array}{r} 964,300 \\ 385,497 \\ \hline \end{array}$ | 27. $\begin{array}{r} 754,608 \\ 430,168 \\ \hline \end{array}$ | 29. $\begin{array}{r} \$8078.82 \\ 6725.39 \\ \hline \end{array}$ |
| 26. $\begin{array}{r} 657,893 \\ 598,987 \\ \hline \end{array}$ | 28. $\begin{array}{r} 765,432 \\ 456,789 \\ \hline \end{array}$ | 30. $\begin{array}{r} \$5432.90 \\ 3876.88 \\ \hline \end{array}$ |
| 31. $\begin{array}{r} 625.08 \\ 16.2845 \\ \hline \end{array}$ | 33. $\begin{array}{r} 457.0023 \\ 83.95 \\ \hline \end{array}$ | 35. $\begin{array}{r} 725. \\ .0238 \\ \hline \end{array}$ |
| 32. $\begin{array}{r} 543.21 \\ 67.8906 \\ \hline \end{array}$ | 34. $\begin{array}{r} 95.0904 \\ 76.543 \\ \hline \end{array}$ | 36. $\begin{array}{r} 1745. \\ 29.0789 \\ \hline \end{array}$ |
| 37. $\begin{array}{r} 312\frac{3}{4} \\ 65\frac{3}{8} \\ \hline \end{array}$ | 38. $\begin{array}{r} 413\frac{3}{8} \\ 27\frac{5}{8} \\ \hline \end{array}$ | 39. $\begin{array}{r} 568\frac{3}{8} \\ 444\frac{3}{16} \\ \hline \end{array}$ |
| 40. $\begin{array}{r} 16 \text{ mi. } 5 \text{ rd.} \\ 5 \text{ mi. } 8 \text{ rd.} \\ \hline \end{array}$ | 42. $\begin{array}{r} 6 \text{ doz. } 6 \\ 3 \text{ doz. } 10 \\ \hline \end{array}$ | 44. $\begin{array}{r} 5 \text{ lb. } 5 \text{ oz.} \\ 3 \text{ lb. } 15 \text{ oz.} \\ \hline \end{array}$ |
| 41. $\begin{array}{r} 12 \text{ wk. } 5 \text{ da.} \\ 4 \text{ wk. } 6 \text{ da.} \\ \hline \end{array}$ | 43. $\begin{array}{r} 10 \text{ yd. } 9 \text{ in.} \\ 5 \text{ yd. } 18 \text{ in.} \\ \hline \end{array}$ | 45. $\begin{array}{r} 10 \text{ gal. } 2 \text{ qt.} \\ 8 \text{ gal. } 3 \text{ qt.} \\ \hline \end{array}$ |

Find the products :

- | | | |
|---------------------------------------|--|--|
| 46. 876×5439 | 50. $\frac{3}{10} \times \frac{5}{6}$ | 54. $.06 \times .0958$ |
| 47. 389×8045 | 51. $38\frac{1}{4} \times 23\frac{1}{8}$ | 55. $315 \times \$84.19$ |
| 48. $7.8 \times \$658.40$ | 52. 6.99×5.076 | 56. $56\frac{1}{4} \times 19\frac{3}{8}$ |
| 49. $\frac{3}{8} \times \frac{5}{16}$ | 53. $.028 \times 2.076$ | 57. 6.908×35.09 |

Find the quotients, carrying decimals to thousandths :

- | | | |
|------------------------------------|---------------------------------------|---|
| 58. $9660 \div 608$ | 62. $\frac{3}{4} \div \frac{2}{5}$ | 66. $587.45 \div 2.38$ |
| 59. $8786 \div 465$ | 63. $25\frac{5}{8} \div 3\frac{1}{8}$ | 67. $5 \text{ gal. } 1 \text{ qt. } \div 3$ |
| 60. $18.75 \div 902$ | 64. $.375 \div .005$ | 68. $6 \text{ ft. } 6 \text{ in. } \div 5$ |
| 61. $\frac{7}{8} \div \frac{3}{4}$ | 65. $28.84 \div 16.7$ | 69. $.60758 \div .095$ |

Change to improper fractions, whole, or mixed numbers.

70. $3\frac{1}{4}$

72. $2\frac{5}{16}$

74. $3\frac{2}{3}$

76. $31\frac{3}{8}$

71. $\frac{35}{8}$

73. $\frac{15}{6}$

75. $\frac{17}{5}$

77. $\frac{48}{12}$

78. Change to lowest terms: $\frac{16}{48}$; $\frac{20}{50}$; $\frac{36}{60}$; $\frac{35}{40}$; $\frac{19}{38}$; $\frac{12}{24}$;
 $\frac{24}{36}$.

79. Change to fractions having the l. c. d.: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$; $\frac{1}{4}$, $\frac{3}{8}$,
 $\frac{3}{16}$; $\frac{3}{5}$, $\frac{1}{10}$, $\frac{4}{15}$; $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

Change common fractions to decimals and to per cents;
 and decimals and per cents to common fractions:

80. $\frac{3}{8}$

83. $\frac{2}{3}$

86. $\frac{5}{6}$

89. $\frac{3}{16}$

81. .25

84. $.37\frac{1}{2}$

87. $16\frac{2}{3}\%$

90. 5.75

82. .50

85. $.62\frac{1}{2}$

88. $87\frac{1}{2}\%$

91. 1.25

Change :

92. 8 yd. to inches

97. 72 in. to yards

93. 3 gal. to quarts

98. 64 qt. to pecks

94. 5 lb. (av.) to ounces

99. $4\frac{1}{2}$ ft. to inches

95. 6 gross to dozen

100. $1\frac{1}{2}$ mi. to feet

96. 5 sq. ft. to sq. inches

101. $2\frac{1}{4}$ lb. to ounces

Find the cost of :

102. 48 yd. @ $12\frac{1}{2}\phi$

106. 60 lb. @ $16\frac{2}{3}\phi$

103. 32 yd. @ $62\frac{1}{2}\phi$

107. 16 lb. @ $87\frac{1}{2}\phi$

104. 27 lb. @ $33\frac{1}{3}\phi$

108. 6 yd. @ \$1.33 $\frac{1}{3}$

105. 32 lb. @ $37\frac{1}{2}\phi$

109. 8 yd. @ \$1.87 $\frac{1}{2}$

Find the number of yards that can be bought for :

AMOUNT	PRICE
110. \$5	\$.50

111. \$10	\$.25
-----------	--------

112. \$4	\$.75
----------	--------

113. \$8	\$.60
----------	--------

AMOUNT	PRICE
114. \$24	\$.12 $\frac{1}{2}$

115. \$33	\$.33 $\frac{1}{3}$
-----------	----------------------

116. \$14	\$.87 $\frac{1}{2}$
-----------	----------------------

117. \$20	\$.40
-----------	--------

Find:

25 % of:	$12\frac{1}{2}$ % of:	125 % of:
118. 40	121. \$160	124. 3240
119. 84	122. \$248	125. 6460
120. 120	123. \$320	126. 8880

Find the profit or loss:

COST	RATE OF GAIN	COST	RATE OF LOSS
127. \$ 50	10 %	129. \$160	$12\frac{1}{2}$ %
128. \$120	25 %	130. \$300	$33\frac{1}{3}$ %

Find the per cent of profit or loss:

COST	SELLING PRICE	COST	SELLING PRICE
131. \$50	\$75	133. \$1000	\$900
132. \$50	\$25	134. \$40	\$45

Find the discount and the net price:

LIST PRICE	RATE OF DISCOUNT	LIST PRICE	RATES OF DISCOUNT
135. \$900	10 %	138. \$1200	$16\frac{2}{3}$ %, 10 %
136. \$160	$12\frac{1}{2}$ %	139. \$400	25 %, 10 %
137. \$500	20 %	140. \$6000	$33\frac{1}{3}$ %, 5 %

Find the commission:

SALES	RATE OF COMMISSION	PURCHASE	RATE OF COMMISSION
141. \$100	10 %	143. \$2000	$2\frac{1}{2}$ %
142. \$500	20 %	144. \$1000	$1\frac{1}{2}$ %

Find the interest and the amount:

PRIN.	RATE	TIME	PRIN.	RATE	TIME
145. \$500	6 %	2 yr.	149. \$7000	6 %	$2\frac{1}{2}$ yr.
146. \$650	5 %	3 yr.	150. \$8500	6 %	3 yr. 4 mo.
147. \$725	4 %	4 yr.	151. \$9500	4 %	2 yr. 15 da.
148. \$1000	$3\frac{1}{2}$ %	2 yr.	152. \$8800	5 %	2 yr. 9 da.



CHAPTER II

SAVING MONEY

Many of you have formed the habit of saving money through the purchase of thrift stamps, or through deposits made in school savings banks. You have observed how deposits increase in value by the interest which they earn.

Interest on the principal and on its unpaid interest, combined at regular intervals, is called **compound interest**.

NOTE. Compound interest is allowed on savings bank accounts, as a depositor has the right to draw his interest and could then deposit it. Example 2 on page 87 is worked by compound interest.

AMOUNT OF \$1 DEPOSITED ANNUALLY FROM 1 YR. TO 5 YR.

PERIODS	2 PER CENT	3 PER CENT	4 PER CENT	5 PER CENT	6 PER CENT
1 yr.	\$1.02	\$1.03	\$1.04	\$1.05	\$1.06
2 yr.	2.06	2.09	2.12	2.15	2.18
3 yr.	3.12	3.18	3.24	3.31	3.37
4 yr.	4.20	4.30	4.41	4.52	4.63
5 yr.	5.30	5.46	5.63	5.80	5.97

1. Find, by reference to the table, the amount of \$5 deposited annually for 3 yr. at 4 % compound interest.

SOLUTION: $5 \times \$3.24 = \16.20 .

2. Find the amount of \$10 at 3 % for 5 yr.

3. Find the amount of \$15 at 4 % for 3 yr.

4. Find the amount of \$100 at 5 % for 5 yr.

SAVINGS BANK ACCOUNTS

When you open an account at a savings bank by depositing money you receive a book in which the amount deposited is entered. This book must be taken to the bank whenever you wish to draw out money.

Savings banks are banks that receive and invest deposits, chiefly savings, and pay interest thereon at stated intervals.

Interest is from 2 % to 4 % annually, and is usually payable the *first of each January and July*. If not drawn when due, the interest is added to the deposit.

For example: If John deposited \$100 Jan. 1, in a bank paying 4 % annually, his amount in the bank July 1 would be \$100 plus six months' interest, \$2, or \$102. The interest for the next 6 months would be computed on \$102.

NOTE. As a rule, interest is reckoned only on deposits made at regular intervals; as, Jan. 1 to Jan. 10, April 1, July 1 to July 10, Oct. 1. Money deposited Jan. 2 to Jan. 10 draws interest from Jan. 1; money deposited Jan. 11 to March 31 draws interest from April 1, etc. Unless otherwise stated, the following examples are to be worked on this basis. Sometimes, however, interest is calculated from the 1st and 15th of each month succeeding the several deposits.

Written Work

How to reckon interest on savings bank accounts.

1. On Jan. 2, 1919, Edith deposits \$10 in the savings bank at 4 % interest. On March 25 she deposits \$5. What amount has she in bank July 1, 1919?

Deposit Jan. 2, 1919	= \$10.
Interest on \$10 at 4 % Jan. 1 to July 1 (2 % for 6 mo.)	= .20
Deposit March 25, 1919	= 5.
Interest on \$5, April 1 to July 1 (1 % for 3 mo.)	= .05
Amount in bank July 1, 1919	= \$15.25

2. On July 1, 1918, Edward Lane makes a savings deposit of \$400 at 4 % interest, payable semiannually. If the interest at each period is added to the deposit, what is the total amount in bank January 1, 1920 ?

NOTE. Savings banks usually allow interest only on the *dollars* of the smallest balance on deposit during the entire term. In the interest, *fractional parts of a cent are omitted.*

Deposit July 1, 1918	= \$400.00
Interest on \$400 at 4 % July 1, 1918, to Jan. 1, 1919	= 8.00
Amount in bank Jan. 1, 1919	= 408.00
Interest at 4 % on \$408 from Jan. 1, 1919, to July 1, 1919	= 8.16
Amount in bank July 1, 1919	= 416.16
Interest at 4 % on \$416 (why?) from July 1, 1919, to Jan. 1, 1920	= 8.32
Amount in bank Jan. 1, 1920	= \$424.48

3. Mary deposits \$5 in the savings bank Jan. 2, 1918. March 1, 1918, she deposits \$6. Find the total amount in bank Jan. 1, 1919, at 4 %, payable January 1 and July 1.

4. James makes the following deposits: Jan. 2, 1918, \$10, Feb. 9, 1918, \$15. Find the total Jan. 1, 1919, at 4 % interest, payable January 1 and July 1.

5. Find the interest July 1, 1919, on a deposit of \$100 made July 1, 1918, at 4 %, payable January 1 and July 1.

6. The total deposits of the pupils in a certain school on Jan. 1, 1916, are \$395.75. Find the amount of these deposits on Jan. 1, 1919, at 4 %, payable January 1 and July 1.

7. Henry's parents put \$100 in a savings bank Jan. 2, 1918, at 4 % interest, payable January 1 and July 1. Find the amount of this deposit Jan. 1, 1919.

8. A newsboy puts \$50 in a savings bank Jan. 2, 1917, \$50 Jan. 2, 1918, and \$50 July 1, 1918. Find the amount in bank Jan. 1, 1919, at 4 %, payable January 1 and July 1.

9. The Jackson Street School has in the savings bank \$508 on Jan. 1, 1918, and makes a deposit of \$230 on April 1, 1918. Find the amount of these two deposits on Jan. 1, 1919, at 4 % interest, payable January 1 and July 1.

10. A school teacher places \$30 in a savings bank the first of October, 1918, and \$30 the first of February, 1919. Find the amount in bank July 1, 1919, at 4 % interest, payable January 1 and July 1.

Find the amount in bank from the following deposits :

DEPOSIT	DATE	RATE	INT. PAYABLE	AMOUNT IN BANK
11. \$ 200	Jan. 2, 1918	3 %	Jan. 1 and July 1	Jan. 1, 1919
12. \$ 150	Mar. 16, 1918	4 %	Jan. 1 and July 1	Jan. 1, 1919
13. \$ 875	May 29, 1918	2½ %	Jan. 1 and July 1	Jan. 1, 1919
14. \$1200	Aug. 10, 1918	2 %	{ Jan. 1, Apr. 1 July 1, Oct. 1	Jan. 1, 1919

15. Find the difference between the simple interest on a note of \$200 dated July 1, 1918, due in two years at 4 %, and the interest on \$200 deposited in a savings bank at 4 % compounded semiannually, for the same period.


16. A savings bank pays 4 % interest, from the 1st and the 15th of each month succeeding the several deposits. The deposits are Sept. 1, \$20; Oct. 10, \$15; Nov. 15, \$20; Dec. 10, \$25. Find the amount in bank the following January 1, if the interest periods are January 1 and July 1.

17. A school has on deposit in the Holmes Savings Bank Jan. 1, 1918, \$495. The deposits are: Feb. 1, \$76; March 1, \$105; April 1, \$114; May 1, \$129; June 1, \$98. Find the amount in the bank Jan. 1, 1919, at 4 % interest, compounded the first of January and July, interest being calculated from the first of each month.

POSTAL SAVINGS SYSTEM

For people who have only small sums of money to deposit at a time the United States government has established a savings bank system in connection with the post office. This is known as the **postal savings system**.

Accounts may be opened with \$1 or more by any person of the age of 10 or over. Smaller amounts than \$1 may be saved for deposit by the purchase of postal savings cards and stamps. No charge is made for the service.

2	NOT TRANSFERABLE. NOT NEGOTIABLE.	POSTAL SAVINGS SYSTEM UNITED STATES OF AMERICA		ISSUE OF 1919	2
	NEW YORK N.Y. Madison Square Station DEPOSITORY OFFICE			X 2507463	
APRIL 10 1919 DATE OF ISSUE				Mary Brown NAME OF DEPOSITOR	
		CERTIFICATE OF DEPOSIT		47144 ACCOUNT NUMBER	
<p>THIS CERTIFIES THAT THE SUM OF TWO DOLLARS HAS BEEN DEPOSITED WITH THE BOARD OF TRUSTEES OF THE POSTAL SAVINGS SYSTEM AND WILL BE PAYABLE</p>					
<p>INTEREST BEGINS ON THE FOLLOWING DATE</p> <p>MAY 1 - 1919</p>		<p>TO THE OFFICE PER PAYMENT OF THIS CERTIFICATE PROPERLY ENDORSED.</p> <p>SAMPLE</p> <p>OF NO VALUE</p> <p>EXPIRY 8 CENT</p>			
		<p><i>[Signature]</i> BOARD OF TRUSTEES</p>			

As receipts for deposits, **postal savings certificates** are issued in fixed denominations of \$1, \$2, \$5, \$10, \$20, \$50, \$100, \$200, and \$500, each bearing the name of the depositor, the number of his account, the date of issue, the name of the depository office, and the date on which interest begins. The depositor signs a duplicate of each certificate, which is returned by the postmaster.

Interest is allowed on all deposits at the rate of 2 per cent per annum, computed on each savings certificate separately, and payable annually. No interest is paid on money that remains on deposit for a fraction of a year only. Deposits bear interest from the first day of the month next following that in which the deposits are made.

Compound interest is not allowed; but a depositor may withdraw interest when due and include it as a new deposit, which will bear interest at the regular rate.

Deposits are **limited** to \$1000 exclusive of interest.

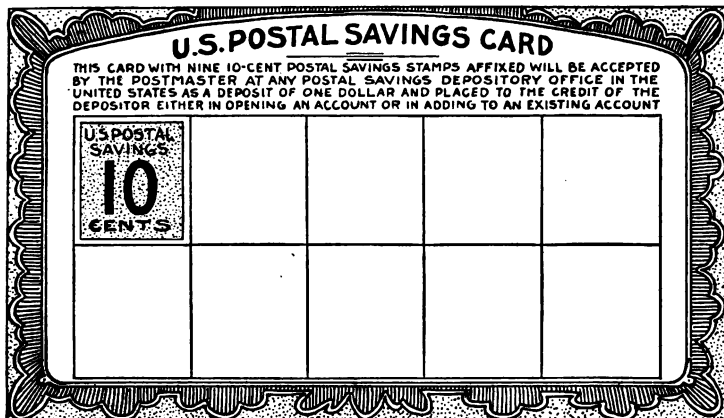
A depositor may exchange his deposits for registered or coupon United States postal savings bonds issued in denominations of \$20, \$100, and \$500, bearing interest at the rate of $2\frac{1}{2}$ per cent per annum, payable semiannually, and redeemable at the pleasure of the United States after one year from date of issue, both principal and interest being payable 20 years from such date in United States gold coin. Such exchange may be made Jan. 1 and July 1 of each year, provided such bonds are then available.

The **withdrawal** of a savings certificate together with any accrued interest may be made at any time on presentation of the certificate properly indorsed. When withdrawing merely the *interest*, the depositor simply signs a receipt for the amount of interest paid.

Oral and Written Work

Find the interest at 2% on:

1. \$25 for 1 yr.
3. \$30 for 2 yr.
5. \$35 for 3 yr.
2. \$50 for 1 yr.
4. \$40 for 2 yr.
6. \$48 for 3 yr.
7. Read the statement on the United States postal savings card on p. 91. How many stamps will fill the card?
8. If I open a postal savings account April 3, 1919, when does interest begin on my first deposit?
9. A boy deposits \$5 a month in a postal savings bank. What amount has he to his credit at the end of a year?
10. If I open a postal savings account with \$10 April 3, 1919, and add \$10 to this account on May 1, 1919, how much interest is due me May 1, 1920?



11. Harry deposits \$2 May 1, 1919, and \$10 June 11, 1919. How much money does the postmaster give him for the certificates July 1, 1920?

12. A \$50 deposit made May 3, 1919, is worth how much at the post office June 1, 1920?

13. On July 1, 1918, John exchanges postal certificates amounting to \$500 for United States bonds. How much interest will be due on them Jan. 1, 1919, at $2\frac{1}{2}\%$ per annum?

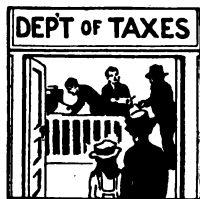
14. James has \$120 on deposit in the postal savings bank and buys two $2\frac{1}{2}\%$ government bonds on January 1,—one for \$20 and one for \$100. How much interest will each of these bonds yield in five years?

15. John deposits \$5 June 2, 1919; \$5 June 9; \$5 June 16; \$5 June 23; and \$5 June 30. Explain when each deposit begins to bear interest. What will be the amount of the deposits July 1, 1920, including interest?

16. Mary deposits 10¢ each week day in the postal savings bank. How many \$1 certificates will she have in 52 weeks?

TAXES

In former times parents had to pay some private school or private teacher for the education of their children. Now everybody can get an excellent education in a public school at the expense of the government. In early days, also, people had no health departments to protect them against disease, no fire departments to give them aid in case of fire, no public provisions for lighting the streets, for building roads and bridges, or for performing many other services. Now all this work is performed for us by the governments of cities, towns, counties, villages, or states. But these governments must collect from the people of the community the money necessary to pay for the cost of school buildings, for the salaries of teachers, and for all the other services.



The money for such expenses is raised by **taxes** on property levied in such a manner that the burden does not fall too heavily on any one man. Thus, a man owning \$10,000 worth of property pays much more than a man owning \$1000 worth ; but he can better afford to pay the greater tax.

Property is of two kinds :

First: **Real property**, such as land and buildings.

Second: **Personal property**, which can be moved from place to place, such as live stock, money, household goods, etc.

There are also **license fees** paid by merchants, owners of dogs, automobiles, etc., **inheritance taxes** imposed by the state and the nation; **income taxes** collected by the national government and by some states ; and other national taxes, which will be explained later.

Most states levy also a **poll tax**, usually amounting to one dollar or more, on each male citizen over twenty-one years of age.

Taxes are collected *yearly* or *semiannually* by a person called a **tax collector** or a **treasurer**.

Taxes are usually levied as so many *mills on a dollar*; thus, 2 mills on a dollar, 2.3 mills on a dollar, etc.; or, as so many *cents on a hundred dollars*; thus, \$.15 on a hundred dollars.

A tax of 2 mills on a dollar is equivalent to .002 of the taxable value. A tax of \$.15 on a hundred dollars equals .0015 of the value.

Steps in levying and collecting taxes.

Assessors place a valuation on every person's real and personal property that is subject to taxation. This is called the **assessed valuation**. The assessed valuation is often less than the full value of the property.

The amount of tax necessary for the public needs is determined for each year. Upon the total assessed valuation the rate necessary to raise the needed tax is then computed.

School boards generally levy all school taxes.

The **tax book** is placed in the hands of the tax collector or treasurer to whom the people pay their taxes.

NOTE. The methods of collecting taxes vary in different places. Pupils should ascertain the methods in their own localities.

Oral Work

1. Find out what kinds of property in your community are taxed for local public needs.
2. Find out who are the assessors in your community and get the assessed valuation of the community property and the rate of taxation.

3. In a town in which the owners pay \$.10 a hundred dollars or 1 mill on a dollar, what is Mr. Gould's tax on property of an assessed valuation of \$5000?

4. In this town the building of a new schoolhouse and new roads raised the tax to \$.17 a hundred dollars. What was the increase in Mr. Gould's tax?

5. A man's property is assessed on the tax book at \$2500, and the tax rate is 2 mills. Find the tax including \$1 poll tax.

SOLUTION. $.002 \times \$2500 = \5 , the tax at the 2 mill rate.

$\$5 + \$1 = \$6$, total tax.

6. Find my taxes on property assessed at \$5000 on which I pay 5 mills on a dollar and \$1 poll tax.

Find the tax on property assessed at :

- | | |
|--|---|
| 7. \$2000, tax levy 3 mills. | 16. \$6000, tax levy 2 mills. |
| 8. \$3000, tax levy 5 mills. | 17. \$1200, tax levy 3 mills. |
| 9. \$5000, tax levy 12 mills. | 18. \$8000, tax levy $3\frac{1}{2}$ mills. |
| 10. \$8000, tax levy 11 mills. | 19. \$6000, tax levy $2\frac{1}{2}$ mills. |
| 11. \$3200, tax levy $2\frac{1}{2}$ mills. | 20. \$3200, tax levy 2 mills. |
| 12. \$5000, tax levy $3\frac{1}{2}$ mills. | 21. \$1000, tax levy 4 mills. |
| 13. \$20,000, tax levy $\frac{1}{2}$ mill. | 22. \$7000, tax levy $\frac{1}{2}$ mill. |
| 14. \$10,000, tax levy $1\frac{1}{2}$ mills. | 23. \$9500, tax levy $1\frac{1}{4}$ mills. |
| 15. \$5250, tax levy $2\frac{1}{4}$ mills. | 24. \$7800, tax levy $3\frac{1}{10}$ mills. |

Written Work

1. Frank Keller's real property is assessed at \$5200, and his personal property at \$800. The tax rate in his city is 13 mills. Find his tax, including \$1 poll tax.

SOLUTION. $\$5200 + \$800 = \$6000$, assessed valuation.

$.013 \times \$6000 = \78 , the tax at the 13 mill rate. $\$78 + \$1 = \$79$, total tax.

Find the missing terms :

ESTIMATED VALUATION	ASSESSED VALUATION	RATE	TAXES	POLL TAX
2. \$ 23,000	\$ 19,000	.002	()	3 polls, \$ 1 each
3. 147,500	80 %	.002	()	2 polls, \$ 2 each
4. 120,000	\$ 95,000	()	\$ 332.50	

5. The following shows the purposes for which each \$100 of expenditures are used by a large city. The total expenditure for this city is \$206,114,136. Find the total cost for each item, to the nearest cent.

For education	\$21.47	For maintaining streets,	
For protecting life and property	15.30	sewers, building inspection, etc.	\$3.45
For health and sanitation	7.98	For docks, ferries, bridges	1.14
For judicial purposes	4.83	For conducting lectures	.62
For charities	5.53	For printing and advertising	.52
For prisons, etc.	.78	For pensions	.72
For public recreation	1.51	For taxes and rents	.50
For administering government	1.67	For the city legislature	.14
		For the city debt	33.84

6. The assessed valuation of a town is \$900,000 and the amount of taxes to be raised is \$16,200. What is the rate of taxation?

SOLUTION. $\$16,200 \div \$900,000 = .018$ on the dollar.

7. A town whose property is assessed at \$1,750,000 needs \$5250 for improvements. What is the rate of taxation?

8. The assessor's book shows the following: John Holt assessed for 50 acres of land at \$200 per acre; 3 cows at \$80 each; 2 horses at \$300 each; poll tax \$1; tax levy $7\frac{1}{2}$ mills. Find the amount of Mr. Holt's tax.

9. The real estate of a town is valued at \$985,400 and the personal property at \$195,600. A tax of \$7866 is

to be raised. There are 780 persons, each assessed a poll tax of \$1. How much tax will be paid by Mr. Bain, a non-resident (paying no poll tax), whose property is assessed at \$12,460?

10. A certain town has 1276 polls assessed at \$1.50 each. The assessed valuation is \$2,675,000, and \$23,314 is to be raised by taxation. Find the rate of tax levy necessary for the required tax.

11. Mr. Bell's property has an actual valuation of \$4800. If he pays 17 mills city tax and $3\frac{1}{2}$ mills county tax on a $\frac{2}{3}$ valuation, in a certain year, find the amount of his tax for that year.

12. How much tax does a farmer pay who owns 90 acres of land valued at \$100 an acre, assessed at $\frac{2}{3}$ of its value, and personal property assessed at \$1250, if the rate of taxation is 3 mills?

13. Mr. Benson receives a tax notice which reads "total assessment, \$9875; borough tax, $5\frac{5}{10}$ mills; school tax, 4 mills; and poll tax, \$1." Find his tax.

14. Taxes that are paid within 60 days from date of notice are generally subject to a reduction of 5%. If Mr. Benson's tax is paid within 60 days, how much discount will he receive?

15. The tax rate in a city is 1.6%. Find Mr. Bell's taxes on a house and lot assessed at \$7000, and on \$4000 worth of personal property.

16. Mr. George Freeman, a real estate broker, owns property valued at \$10,000. He pays a yearly city tax of 12 mills on an 80% assessment, and a county tax of 2 mills on a 70% assessment. Find his yearly expenses for taxes.

17. The five principal items of a state revenue of \$18,000,000 were as follows: tax on railroad corporations,

\$4,400,000; tax on other corporations, \$2,400,000; state school tax, \$5,500,000; tax on railroads, \$2,297,000; inheritance tax, \$904,000. Find, to the nearest tenth per cent, what per cent of the total taxation each item paid.

18. A county with a valuation of \$90,000,000 paid a state school tax of $2\frac{3}{10}$ mills. 90 % of this tax was returned to the county for use in support of its schools. How much did the county receive?

19. The tax on property in the city of Warren amounted one year to \$289,500. What was the tax rate if the assessed valuation was \$16,000,000? How much would a property owner in Warren pay, having a property worth \$35,000, assessed at 60 % of its value?

20. \$250,000 worth of bonds (see p. 236) paying $4\frac{1}{2}$ % interest were issued in one year. How much did that increase the tax rate for Warren the next year, to meet the annual interest?

21. A new school building costing \$120,000 was erected. Bonds at 4 % were issued to pay for this, and 2 % of the value of the bonds issued was set aside each year as a sinking fund. What increase in the tax rate did this cause?

The principal expenditures in Warren were *for lighting*, \$23,500; *streets*, \$44,000; *police department*, \$23,100; *salaries of city officials*, \$16,400; *fire department*, \$16,000.

22. Of the expense for streets, 8 % was for cleaning, 23 % for sprinkling, and 33 % for regrading and rebuilding streets with gravel. What was the expenditure for each item?

23. Of the expense for the fire department, \$900 was for fuel, \$3400 for salaries, and \$4200 for supplies. What per cent of the total expense was caused by each of these items?

24. What per cent of the expense for streets was the expense for lighting?

25. What per cent of the expense for the police department was that for the fire department?

26. What per cent of the expense for salaries of officials was that for the fire department?

27. \$133,000 was expended for a system of schools ; $50\frac{1}{2}\%$ was raised by local taxation and the rest was a state appropriation. What was the amount of each?

28. If the valuation of property in Ex. 27 was \$14,000,000, what was the rate of the local school tax, to nearest tenth of a mill?

29. Of the total expense of \$133,000, \$79,000 was for teachers' salaries, \$6500 for fuel, and \$6000 for repairs. What per cent of the total was each of these items?

30. An increase of \$4000 was made in teachers' salaries, a new building for storing coal cost \$2000, and \$2500 was spent in erecting fire escapes. How much, to nearest tenth of a mill, did this add to the tax rate on \$14,000,000?

31. In a certain state each school district received \$600 for a supervising principal, \$400 for each high school teacher, \$200 for each elementary school teacher, and a certain amount for each day's attendance of a pupil.

A school district had a supervising principal, 15 high school teachers, and 70 elementary school teachers. Its yearly attendance was 419,000 days. The apportionment for one day's attendance was $9\frac{15}{100}\text{¢}$. How much did this district receive from the state?

32. A school numbering 820 pupils was in session 188 days and had an average attendance of 91 %. How much did it receive from the state for attendance, if the apportionment was $8\frac{7}{10}\text{¢}$ for one day's attendance for each pupil?

NATIONAL TAXES

Our national government needs money to pay for the salaries of the President and other officers, for the support of the army and the navy, for the post office, and for many other purposes. The receipts are of two kinds: *internal revenues* and *custom revenues or duties*.

Internal revenues consist of taxes on beverages, tobacco, luxuries, etc., on incomes, and on inheritances.

For example: Taxes on corporations in one year amounted to \$24,996,000; on manufacturers of or dealers in automobiles and motor cycles, \$23,981,000; and on munition manufacturers, \$13,296,000. Documentary stamp taxes produced \$18,813,000. Club dues, taxed at 10 per cent, yielded \$2,259,000. Taxes on insurance policies yielded \$6,492,000; on oleomargarine, \$2,336,000; on bowling alleys, pool and billiard tables, \$1,086,000; on theater, circus, and museum proprietors, \$865,000; and on stock brokers, \$333,000.

The internal revenue receipts in 1918 were \$3,694,703,334. The tax on spirits yielded \$317,553,687; on fermented liquors, \$126,285,857; on tobacco, \$156,188,660; income tax, \$2,839,083,585; and other miscellaneous taxes, \$255,591,545.

1. What per cent of the total tax (to the nearest tenth per cent) was the tax on spirits? on fermented liquors? on tobacco? on incomes? on miscellaneous articles?

2. In 1918 the total tax collected amounted to \$3,694,703,334 and the amount of tax on excess profits was \$283,908,300. What per cent was this of the total tax?

3. The inheritance tax amounted to \$47,452,880. What per cent was this of the total tax of \$3,694,703,334?

4. The income tax on individuals and corporations in one year was \$359,647,971. What per cent was paid by corporations paying \$179,539,631? by individuals paying \$180,108,340?

CUSTOMS OR DUTIES

If any of you have traveled in Canada or some other foreign country, you will remember that on your return to the United States a customhouse officer examined your baggage to see whether you had brought back any articles that required the payment of duties.



Duties or custom revenues are taxes on goods imported from foreign countries. These are collected at the customhouses, which are maintained by the government at various **ports of entry**.

A schedule of duties on imports fixed by our government is called a **tariff**.

All imported merchandise is classified as follows:

- (1) Merchandise on the **free list**, that is, free of duty.
- (2) Merchandise subject to an **ad valorem duty**, that is, a certain per cent of the cost of the goods.

Invoices are statements showing the market price of goods, expressed in the money of the country where the goods are bought.

- (3) Merchandise subject to a **specific duty**, that is, to a certain amount per yard, pound, etc., without regard to value.

- (4) Merchandise subject to both an **ad valorem** and a **specific duty**.

For example, the duty on perfumery is 40¢ a pound *specific* and 60 % *ad valorem*.

Duties are not computed on parts of a dollar. If the invoice shows a number of cents less than 50, they are rejected in computation of duties, while 50 cents or more are counted as another dollar.

Written Work

Find the duty on the following imports:

1. \$10,000 worth of porcelain, *ad valorem* duty, 20 %.

2. 2500 gross of pens, specific duty, 8¢ a gross.
3. \$3428 worth of sponges, ad valorem duty, 10 %.
4. \$2650 worth of yarns, ad valorem duty 18 %.
5. \$15,000 worth of furs, ad valorem duty 40 %.
6. 2300 bu. flaxseed, specific duty 20¢ a bushel.
7. \$4650 worth of dress goods, ad valorem duty 35 %.
8. \$6250 worth of clocks, ad valorem duty 30 %.
9. 100 doz. pairs leather gloves, specific duty \$4.75 a dozen pairs.
10. \$2650 worth of toys, ad valorem duty 35 %.
11. 2400 pounds of butter, duty $2\frac{1}{2}$ ¢ a pound.
12. \$5000 worth of blankets, ad valorem duty 25 %.
13. 800 yd. Brussels carpet valued at \$1.65 a yard, ad valorem duty 25 %.
14. 500 boxes cigars (each weighing 1 lb. and containing 100 cigars) invoiced at \$3.50 a box, duty 25 % plus \$4.50 a pound.
15. The specific duty on grape sugar is $1\frac{1}{8}$ ¢ a pound. If the duty is \$135, find the number of pounds imported.
16. A department store in Buffalo imported from London flannels invoiced at \$6400 at an ad valorem duty of 30 %. How much duty was paid?
17. A merchant imported from Sheffield, England, 12 gross table knives costing \$3 a dozen. If the duty was 30 % ad valorem, and transportation cost \$9.60, find the cost per dozen, delivered.
18. A certain painting in Rome was purchased for 50,000 lire (\$193). Find the cost when delivered in New York, if the duty was 15 % and freight and insurance cost \$49.75.
19. Brown and Company imported 1200 sacks of chocolate, each containing 90 lb. Find the duty at 2¢ a pound.

INSURANCE

FIRE INSURANCE

The Boys' Boating Club put up a new boat house which, with the boats, was valued at \$2000. They wished to make sure that in case of fire their loss would be repaid. In return for a fee or **premium** of \$10 a year they found that an insurance company would agree to pay them enough to replace their property in case of loss by fire. The company was able to do this because many people who paid them yearly fees for fire insurance never had any losses. These fees enabled the company to pay the losses of the people whose property was destroyed, so that the burden did not fall too heavily on any one person.

Security against loss or damage is called **insurance**.

A merchant owns a store valued at \$5000. An insurance company agrees to insure it for \$4000 at 1 % annually. In case it is totally destroyed by fire, how much must the company pay the merchant? How much must the merchant pay annually to guarantee this loss?

A written contract between the person insured and the insurance company is called a **policy**. The amount of insurance written in the contract is called the **face** of the policy.

The fee paid for the insurance is called a **premium**.

The greater the risk, the greater is the premium charged by the insurance company. Thus, while the premium on a frame paint shop containing inflammable material might be \$2.50 per \$100, the premium on a near-by fireproof dwelling might be only \$.20 per \$100.

The length of time for which the insurance is taken out is called the **term of insurance**.

A certain sum per \$100 of insurance, or a certain per cent of the sum insured, is called the **rate**.

The term is usually a year or a period of years. **Short rates** are rates charged when the term is less than one year.

Sometimes property is insured for its full value and sometimes only for part of its value, as 75 % or 80 % of it.

Written Work

1. A frame dwelling is insured for \$2800 for one year at $1\frac{1}{4}$ %. Find the premium.

SOLUTION. The premium is $1\frac{1}{4}$ % of \$2800, or \$49.

What are the premiums on the following policies at the rates given?

- | | | |
|-------------------------------|-------------------------------|-------------------------------|
| 2. \$14,500, $1\frac{3}{4}$ % | 4. \$11,400, $2\frac{1}{4}$ % | 6. \$18,900, $3\frac{1}{4}$ % |
| 3. \$9200, $1\frac{1}{2}$ % | 5. \$5600, $2\frac{1}{2}$ % | 7. \$16,700, $1\frac{1}{4}$ % |

What are the premiums on the following policies at the given premiums per \$100?

- | | | |
|---------------------|---------------------|----------------------|
| 8. \$9600, \$.75 | 10. \$7900, \$.45 | 12. \$15,600, \$1.25 |
| 9. \$24,500, \$1.75 | 11. \$67,000, \$.60 | 13. \$8700, \$.90 |

14. A brick house is insured for \$4000 at 60¢ on \$100. Find the rate of premium and the annual premium.

15. If the three-year rate is twice the rate for one year, find the cost of insuring a brick dwelling for \$6500, for 3 years, when the annual rate is 45¢ per \$100.

16. A store building is insured for \$8500 at an annual premium of \$212.50. Find the rate of premium and the annual cost per \$100 of insurance.

17. A school board pays annually \$45 for \$6000 of fire protection on a school building. Find the rate of premium.

18. The premium on a dwelling insured for \$5500 is \$38.50 for 3 yr. Find the average rate for 1 year.

19. Mr. Lord writes a check for \$31.50 to pay for the insurance on his dwelling for 3 yr. If the house is worth \$2400 and is insured for $\frac{3}{4}$ of its value, find the rate for the term.

20. A farmer insures his house for \$2700 at $1\frac{1}{4}\%$, his barn for \$1200 at $\frac{7}{8}\%$, and his furniture for \$900 at 1%. What premium does he pay?

21. The premium on 8000 bu. of corn, valued at \$1.25 per bushel, and insured for $\frac{4}{5}$ of its value, is \$57.60. Find the rate of insurance.

22. A jewelry store is insured for \$20,000, and its contents, for \$27,000. The premium is \$705. What is the rate of insurance?

23. A clothier insures his stock of goods, valued at \$12,000, for 1 yr. at $1\frac{1}{4}\%$. At the end of 6 mo. he surrenders his policy. If the "short rate" for 6 mo. is 90¢ per \$100, how much premium is returned?

24. A farmer insures his buildings for \$3500 at $1\frac{1}{2}\%$ for a term of 3 yr. After he has paid the premium for 4 terms, the buildings are totally destroyed by fire. What is the farmer's loss? What is the company's loss?

25. A vessel worth \$27,000 is insured for $\frac{3}{4}$ of its value at $3\frac{1}{4}\%$. In case of shipwreck, what is the company's loss? What is the owner's loss?

26. A business block valued at \$300,000 is insured in four different companies, the rate of each being 1%. The first company takes \$50,000; the second, \$60,000; the third, \$90,000; and the fourth, the remainder. After the premiums have been paid four times, the block is damaged by fire to the amount of \$120,000. What is the loss of each company?

LIFE INSURANCE

The principal kinds of personal insurance are **life insurance**, **accident insurance**, and **health insurance**.

Accident insurance and **health insurance** are taken as protection in case of loss of income through incapacity caused by accident or illness.

People insure their lives so that their families may be provided for in case the breadwinner should die. The following are the principal kinds of **life insurance** policies :

1. An **ordinary life** policy guarantees a fixed sum of money on the death of the insured. The premiums on such a policy run for life.

2. A **twenty-payment life** policy, payable at death, is paid up by twenty annual premiums.

3. In an **endowment** policy the face of the policy is guaranteed to the insured if he is living at the end of the endowment period, or to his estate if his death occurs before the time.

4. In a **term** policy the face of the policy is paid only if the insured dies within the term of the policy. Term policies may be exchanged within a stated time for ordinary life policies at a higher premium.

Most insurance companies pay annual dividends, thus reducing the cost of the insurance.

ACTUAL ANNUAL PREMIUMS PER \$1000 INSURANCE, AS ISSUED
BY AN INSURANCE COMPANY

AGE	ORDINARY LIFE	20-PAYMENT LIFE	20-YEAR ENDOWMENT	20-YEAR TERM
20	\$ 18.95	\$ 27.64	\$ 45.98	\$ 12.48
25	21.14	30.05	49.35	13.34
30	23.96	32.98	50.74	14.61
35	27.63	36.62	51.88	16.70
40	32.48	41.18	53.69	20.15
45	39.02	47.09	56.70	25.85
50	47.79	54.98	61.75	35.00
55	60.33	65.81	70.02	
60	77.48	81.09		

Written Work

Rates as given in the table on page 105.

1. What is the premium on an ordinary life policy of \$5000 at the age of 30?
2. A man at the age of 25 takes out a \$2000 ordinary life policy. If he dies after paying 16 premiums, what per cent of the face of the policy has been paid in premiums?
3. If in Ex. 2 the insured had taken a 20-payment life policy, what per cent of the face of the policy would have been paid in premiums?
4. A young man at the age of 20 takes out a 20-payment life policy for \$2000. The dividends at the end of 20 years amount to \$142 per \$1000. What is the net cost of this insurance at the expiration of this policy, if the interest on the premiums is not considered?
5. What is the premium on a 20-year endowment policy for \$5000 at the age of 40?
6. The first annual premium on a 20-year endowment policy for \$8000 amounts to \$453.60. What is the age of the insured?
7. If a man 25 years old takes out a 20-year term policy for \$3000, how much will he have paid for his insurance at the close of the term?
8. A man at the age of 25 takes out a 20-payment life policy for \$1000. His dividends for the 20 years amount to \$150.45. What is the amount of his premiums, less the dividend?
9. Mr. Lord pays \$24 a year for 3 yr. for an accident insurance policy, which agrees to pay him \$200 a month for illness due to accidents in traveling. In the third year he is ill three months through such an accident. What is the net value of the insurance?



SCHOOL SHOP WORK

Oral and Written Work

NOTE. Each pupil should be supplied with a ruler showing half inches, quarter inches, eighth inches, and sixteenth inches, a straight-edge a pair of compasses, and a protractor.

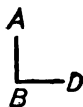
Teachers should use their judgment about assigning to girls problems on shop work, etc., which are usually of greater interest to boys.

Some courses of study provide for the teaching of School Shop Work in the eighth year. In such cases this section may be deferred without interrupting the sequence.

Lines that cannot meet however far they are extended are called **parallel lines**.

1. Draw two parallel lines $\frac{1}{4}$ in. apart.
2. Point out parallel lines in the picture above.
3. What is a right angle? Draw a right angle.
4. Name several objects that have right angles.

Lines drawn at right angles to each other are **perpendicular**; AB is perpendicular to BD .



5. Draw a line on the blackboard 1 yd. in length. Then draw five lines parallel to the first line, each line 2 in. below the former line. Then draw five lines perpendicular to these lines, 2 in. apart.

6. Divide a line, 18 in. in length, into half inches; into quarter inches; into eighth inches.

7. Take a board 3 ft. in length and, beginning 4 in. from each end, divide the space into 4 equal parts.

8. The end of a house is 28 ft. Show the spaces for frames, each $3\frac{1}{2}$ ft. wide, if the windows are to be 4 ft. from each end.

9. Draw a diagram showing spaces for hat hooks on a board 12 ft. in length, if the hooks are set 6 in. apart.

10. The front of a house is 40 ft. in length. It has one door $3\frac{1}{2}$ ft. in width and two windows, each 60 in. in width. Draw a diagram showing the door in the center and the windows in the centers of the spaces on each side of the door.

11. A hallway is 8 ft. in width and 16 ft. in length. Make a diagram showing the hallway on a scale of 1 foot to 1 inch.

12. The end of a room is 14 ft. 6 in. Draw a 4-foot window in the center of the side.

13. A bedroom 12 ft. by 16 ft. has windows on one side and one end. Draw a diagram showing a 4-foot window, 5 ft. from the end of the side and a $3\frac{1}{2}$ -foot window in the center of the end.

14. On one side of a chicken house 24 ft. in length James puts four small windows each 18 in. in width. Draw a diagram showing the windows placed equal distances apart.

15. The library is 15 ft. in width. Draw a diagram showing the mantel 5 ft. wide and the fireplace 3 ft. wide placed in the center.

16. A floor is 10 ft. by 24 ft. How many tiles 6 in. square will it take to lay it? Draw a diagram 1 foot to 1 inch to illustrate this.

17. Draw on a scale of 1 foot to $\frac{1}{8}$ inch lines to represent 16 ft. ; 24 ft. ; 60 ft. ; 100 ft. ; 120 ft.

CUTTING FROM PATTERNS

NOTE. In the following exercises, no allowance is to be made for waste. The sign " is often used for *inch* or *inches* and the sign ' for *foot* or *feet*.

1. A decorator uses a burlap pattern $12'' \times 18''$. Make a diagram, on a convenient scale, to show how many such pieces can be cut without waste from a piece of burlap 6 yd. long and 2 yd. wide.

2. Mrs. Long needs 15 pieces of cheesecloth, each $12'' \times 14''$. Make a diagram to show how many pieces can be cut from a piece of cloth 3 yd. in length by 1 yd. in width. How much will be wasted?

3. A calendar firm makes blotters for calendars $3\frac{3}{4}'' \times 9''$. The blotter paper from which they are cut is 1 yd. square. How many blotters can be cut from each piece?

4. The industrial school makes school bags from patterns $12'' \times 18''$. Show the number of patterns that can be cut from a piece of cloth 10 yd. long and 1 yd. wide.

5. How many book covers $7'' \times 24''$ can be cut from paper $36'' \times 48''$?

6. Colored rectangles $3\frac{1}{2}'' \times 6\frac{1}{2}''$ are to be cut from cardboard for decorations. How many rectangles can be cut from a piece 1 yd. square?

7. The side design on a book bag is $4\frac{1}{4}'' \times 7''$. How many such designs can be cut from a piece of cloth 1 yd. square?

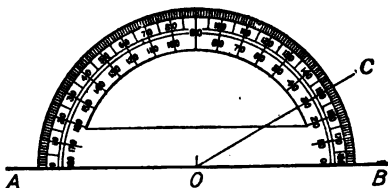
8. A design is $15'' \times 54''$. How many such designs can be cut from a piece of burlap 3 yd. long by $2\frac{1}{2}$ yd. wide?

9. Mrs. Grey makes burlap plate holders to sell at a charity bazaar. How many $8'' \times 12''$ holders can she cut from 1 yd. square of burlap? How many $7\frac{1}{2}'' \times 12''$ holders?

ANGLES

Angles are measured by an instrument called a **protractor**.

When the center O of the protractor is placed at the vertex of the angle to be measured, the size of the angle may be seen on the scale between the lines that form the angle. Thus, BOC is an angle of 30° , and AOC is an angle of 150° .



Every circumference contains 360 degrees (360°); each degree, 60 minutes ($60'$); and each minute, 60 seconds ($60''$).

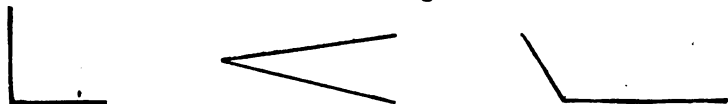
TABLE OF ANGULAR AND CIRCULAR MEASURE

60 seconds ($''$)	= 1 minute ($'$)
60 minutes	= 1 degree ($^\circ$)
360 degrees	= 1 circumference (C)

The length of a degree at the equator is $69\frac{1}{4}$ miles.

Draw an angle of 90° ; 45° ; 60° ; 120° ; 30° .

Kinds of Angles



Which one of these angles is a right angle? Why? Which is less than a right angle? Which is greater than a right angle?

An angle of 90° is called a **right angle**.

An angle less than 90° is called an **acute angle**.

An angle greater than 90° and less than 180° is called an **obtuse angle**.

WOODWORK

1. On a piece of wood 4 in. wide and 15 in. long, make a mortise 1 in. wide and 2 in. long, equal distances from the ends and sides.

2. The four legs of a stand are 15 in. long and 2 in. square. A brace 1 in. by 3 in. is mortised into the legs 4 in. from the foot of the legs, and 1 in. in depth. Draw a diagram to show the mortise joint if the mortise is $\frac{1}{2}$ in. from each edge.

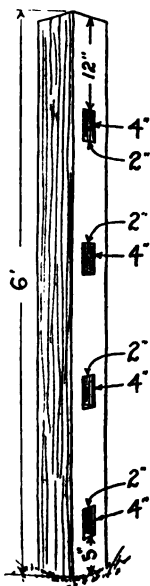
3. A piece of wood is 4 in. square and 6 ft. long. Draw a diagram to show 4 mortise joints, each 1 in. by 3 in., if they are equal distances apart, and the top and bottom joint are 1 ft. from the ends.

4. Show by a diagram the location of mortise joints 1 in. by 2 in., at equal distances from the sides and ends of a piece of wood 4 in. wide and 12 in. long.

5. The legs of a plant stand are 2 in. square and 18 in. high. Show a mortise of 1 in. by 2 in., in the center of one side of the leg. Make a diagram.

6. Space on a post 6 in. square and 8 ft. high, four mortise joints 2 in. by 4 in., beginning 1 ft. from the top and bottom. Space the mortises on paper.

7. Read this diagram of a fence post with four holes mortised for rails. How far is the first hole from the ground? the last hole from the top of the post? How high is the post? Give the dimensions of each mortise hole.



8. The back of the key rack shown in Fig. 1 is 10" long. How many hooks can be put in one row on the rack, if the

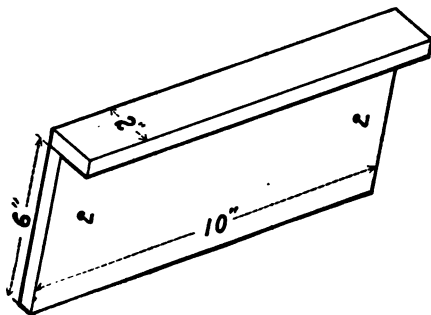


FIG. 1.

hooks are $\frac{3}{4}$ " apart, and are started $1\frac{1}{4}$ " from the edge on each end? (Space between end hooks = $10" - 2\frac{1}{2}" = 7\frac{1}{2}"$.)

9. The shelf of the key rack is 2" in width. The back board is 6" in width. How many square inches of wood are there in each piece?

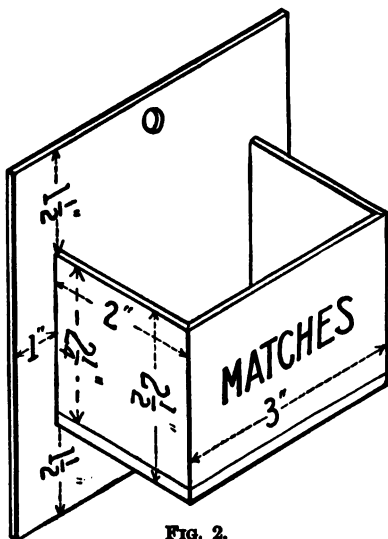


FIG. 2.

10. The match box shown in Fig. 2 is made of wood $\frac{1}{4}$ " thick. How many square inches of wood will it take to make the box if the back board is $5" \times 5\frac{1}{2}"$, the front of the box $3" \times 2\frac{1}{4}"$, each of the two sides of the box, $2" \times 2\frac{1}{4}"$, and the bottom of the box, $3" \times 2"$?

11. What is the length of a board 6" in width necessary to make the whisk-broom holder shown in Fig. 3, if the back is 6" \times 8", the front 4" \times 5" (4" at longer end), and the side pieces are each 1½" in width?

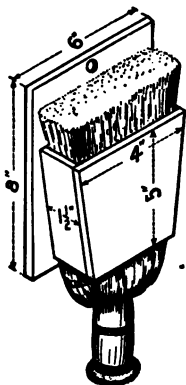


FIG. 3.

NOTE. For the front, a board 5" \times 6" is needed; and for the two side pieces, a board 3" \times 6".

12. Frank builds the footstool shown in Fig. 4 out of a board 10" in width by 34" in length. How many square inches of wood are wasted if the top is 8" \times 14", the legs are 7" \times 8", and the braces, 2½" \times 10", not allowing for notches in legs and braces?

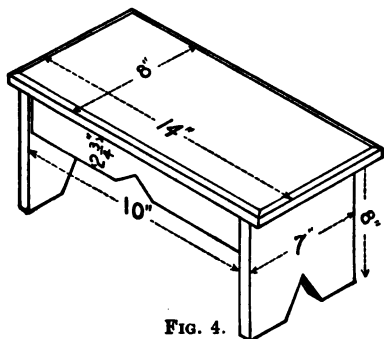


FIG. 4.

13. Show by a diagram the best way to cut the board with the least possible waste.

14. How high will the bookstand shown in Fig. 5 be if the shelves are 12" apart, the bottom shelf being 6" from the

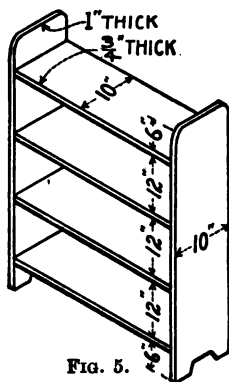


FIG. 5.

floor, and the top of the stand 6" above the top shelf? The upright boards are each 1" thick, and the shelves, ¾" thick.

15. How many square feet of lumber are there in the stand if the shelves are 10" in width and 36" in length, and the sides are the same width as the shelves?

16. How many books will the stand hold if the average thickness of each book is $\frac{3}{4}$ "? How many books 1" thick?

17. The plant stand shown in Fig. 6 is 18" in height. The board on the top is 14" square and $\frac{3}{4}$ " in thickness. How long a piece of wood will it take for the four legs?

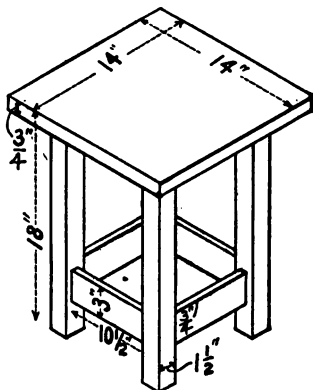


FIG. 6.

18. The legs are each $1\frac{1}{2}$ " square, and the four braces between the legs are each 3" \times 10 $\frac{1}{2}$ ". How many square feet of boards are there in the braces and the top if braces are set into the legs $\frac{1}{2}$ ", making a mortise joint?

19. How far does the top extend beyond the legs?

20. Each section of the screen in Fig. 7 is 30" by 72". The horizontal pieces, 30" in length, are fastened on the back of the upright pieces. Find the number of square feet of lumber in the frame, if the cross pieces are 5" wide. Find also the number of square feet of burlap necessary to cover the entire back.

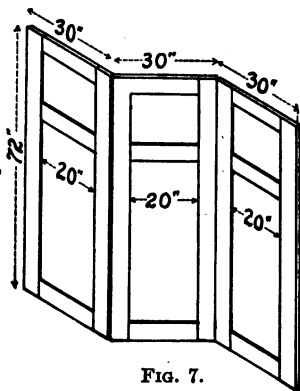


FIG. 7.

21. A boy has a board 12 $\frac{1}{4}$ " \times 3'. How many blocks 4" square could he saw out of the board, allowing $\frac{1}{8}$ " saw cut?

22. The door of the house in Fig. 8 is 4' wide and the windows are each 3' wide. If the house is 40' front, how

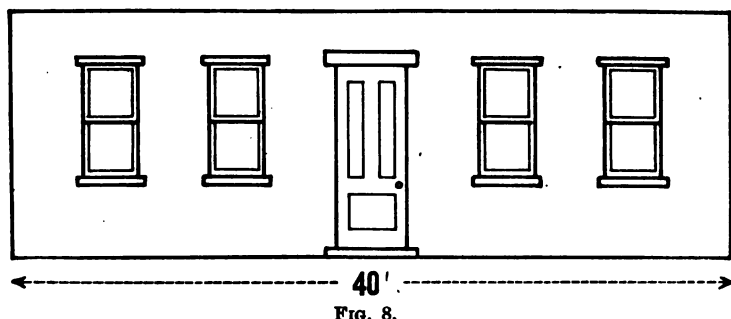


FIG. 8.

wide are the equal spaces between door and windows?

23. If this house is built on a lot 50' wide and 160' deep, and the house is 40' by 40', with a front veranda 10' by 35' and a back porch 8' by 12', how many square feet will be left for walks and lawn?

24. A carpenter is building the cabinet shown in Fig. 9. The wood for the sides is $\frac{3}{4}$ " thick. The strips between the drawers are $\frac{3}{4}$ ". How high will the cabinet have to be if the large drawers are 8" high, and the small ones 4", and the lowest strip is 4" from the floor?

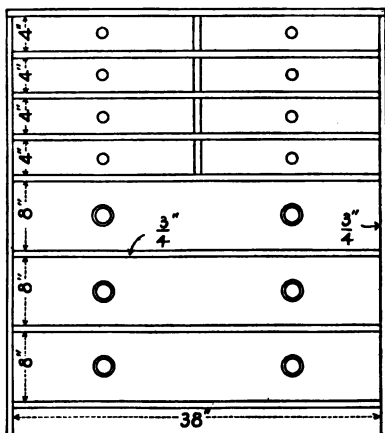


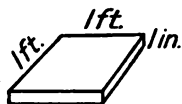
FIG. 9.

25. How many square feet of wood will be required to cover the back, which is 38" wide and 46" long?

LUMBER

Any kind of sawed timber, as boards, planks, sills, etc., is called **lumber**.

The unit of lumber measure is the board foot, which is a square foot 1 inch or less thick.



ONE BOARD FOOT

NOTE. Boards less than 1 inch thick are measured as if they were 1 inch thick; boards over 1 inch thick are measured by their actual thickness in inches and fractions of an inch. "Foot" is often used for "board foot."

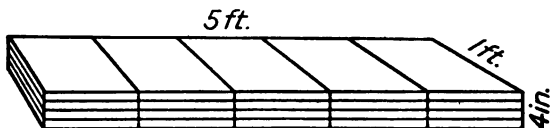
The number of board feet in a board 1 inch (or less) in thickness equals the number of square feet of surface in one side of the board.

Thus, a board 1 in. or less thick, 6 in. wide ($\frac{1}{2}$ ft.) and 10 ft. long contains $10 \times \frac{1}{2}$ bd. ft., or 5 bd. ft.

1. How many board feet are there in a board 1 in. thick, 9 in. wide, and 3 ft. long?

2. How many board feet are there in a sill 4 in. thick, 1 ft. wide, and 5 ft. long?

SOLUTION. $4 \times 1 \times 5 = 20$. Ans. 20 bd. ft.



The number of board feet in a piece of lumber more than 1 inch thick equals the product of the number of board feet (or square feet) in one surface by the number of inches in thickness.

3. Find the number of board feet in a sill 8 in. thick, 10 in. wide, and 18 ft. long.

SOLUTION. $\frac{2}{3} \times \frac{10}{12} \times 18$. Ans. 120 bd. ft.

NOTE. In billing lumber the number of pieces is written first, then the thickness, followed by the width and the length.

Find the number of board feet in the following :

4. 1 board, $1'' \times 6'' - 10'$
5. 1 board, $\frac{3}{4}'' \times 10'' - 16'$
6. 2 boards, $\frac{1}{2}'' \times 9'' - 15'$
7. 5 planks, $3'' \times 12'' - 8'$
8. 2 sills, $10'' \times 10'' - 12'$
9. 3 beams, $10'' \times 12'' - 40'$

People who deal in lumber usually make a table like the following of the different sizes in stock:

Length in feet	$1'' \times 6''$ or $2'' \times 3''$	$1'' \times 8''$ or $2'' \times 4''$	$1'' \times 12''$ $2'' \times 6''$ or $3'' \times 4''$	$2'' \times 8''$ or $4'' \times 4''$	$3'' \times 6''$
6 ft.	3	4	6	8	9
8 ft.	4	$5\frac{1}{2}$	8	$10\frac{1}{2}$	12
10 ft.	5	$6\frac{1}{2}$	10	$13\frac{1}{2}$	15
12 ft.	6	8	12	16	18
14 ft.	7	$9\frac{1}{2}$	14	$18\frac{1}{2}$	21
16 ft.	8	$10\frac{1}{2}$	16	$21\frac{1}{2}$	24
18 ft.	9	12	18	24	27
20 ft.	10	$13\frac{1}{2}$	20	$26\frac{1}{2}$	30

10. Find the number of board feet in a piece of lumber $2'' \times 4'' - 18'$.

SOLUTION. In the $2'' \times 4''$ column on the 18' line, the number 12 represents the answer, 12 board feet.

Use the table to find the number of board feet in :

11. 1 board $1'' \times 6'' - 16'$
12. 2 boards $2'' \times 6'' - 20'$
13. 1 timber $4'' \times 4'' - 14'$
14. 1 timber $3'' \times 4'' - 18'$
15. 1 plank $3'' \times 6'' - 20'$
16. 2 planks $2'' \times 8'' - 14'$

Lumber is bought and sold by the *thousand board feet*. In practice, the cost is computed at so much a board foot. Thus, \$90 a thousand feet (M) = \$.09 a board foot.

Show that \$95 per M = \$.095 per board foot and that \$60 per M = \$.06 per board foot.

17. Estimate the cost of 6389 ft. of lumber at \$60 per M ; of 7000 ft. at \$65 per M.

18. Estimate the cost of 972 ft. of lumber at \$82 per M ; of 693 ft. at \$97 per M.

19. Estimate the cost of 200 planks $3'' \times 12'' - 15'$ at \$.095 per board foot.

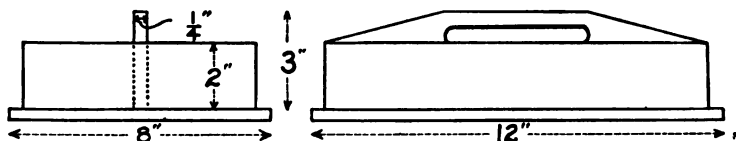
Find the cost, at \$88 per M, of :

20. 75 boards, $1'' \times 10'' - 18'$.
21. 45 boards, $1'' \times 5'' - 16'$.
22. 120 studding, $2'' \times 4'' - 12'$.
23. 400 planks, $2'' \times 12'' - 16'$.
24. 300 boards, $1'' \times 10'' - 14'$.
25. 600 boards, $1'' \times 6'' - 16'$.
26. 100 boards, $\frac{3}{4}'' \times 12'' - 16'$.
27. 15 sills, $6'' \times 10'' - 20'$.
28. 250 joists, $2'' \times 8'' - 24'$.
29. 70 sills, $10'' \times 12'' - 30'$.
30. 125 sleepers, $3'' \times 10'' - 28'$.
31. 200 boards, $\frac{1}{2}'' \times 4\frac{1}{2}'' - 16'$.
32. 500 joists, $2\frac{1}{2}'' \times 8'' - 20'$.
33. 325 planks, $3'' \times 14'' - 16'$.
34. 300 sills, $5'' \times 8'' - 24'$.
35. 50 posts, $10'' \times 12'' - 14'$.
36. 400 studding, $2'' \times 3'' - 18'$.
37. 500 boards, $1\frac{1}{2}'' \times 10'' - 16'$.
38. 400 joists, $3'' \times 6'' - 20'$.
39. 50 boards, $1'' \times 12'' - 16'$.
40. 60 boards, $1\frac{1}{2}'' \times 10'' - 12'$.
41. 100 boards, $\frac{3}{4}'' \times 6'' - 15'$.

42. A bookcase has three shelves 8" wide and 18" long. The two sides are 9" wide and 25" long. The wood used is $\frac{5}{8}$ " thick and costs 10¢ a board foot. How much will the material for the case cost, allowing 1 foot for waste?

43. If the material is worth 9¢ a board foot, what will be the value of a box and cover, 14" long, 4" wide, and 5" high, not taking into account the labor?

44. Find the value of a box and cover, 12" long, 5" wide, and 2" high, made of material worth 10¢ a board foot.



WORKING SKETCH OF KNIFE AND FORK BOX (Material $\frac{1}{4}$ " white wood)

45. What are the dimensions and the area of the bottom of this box?

46. What is the length of each side if the bottom board projects $\frac{1}{2}$ " all around?

47. The sides are nailed over the ends. What is the length of each end?

48. How long a strip will be required to make the sides and the ends, allowing $\frac{1}{2}$ " on each piece for squaring?

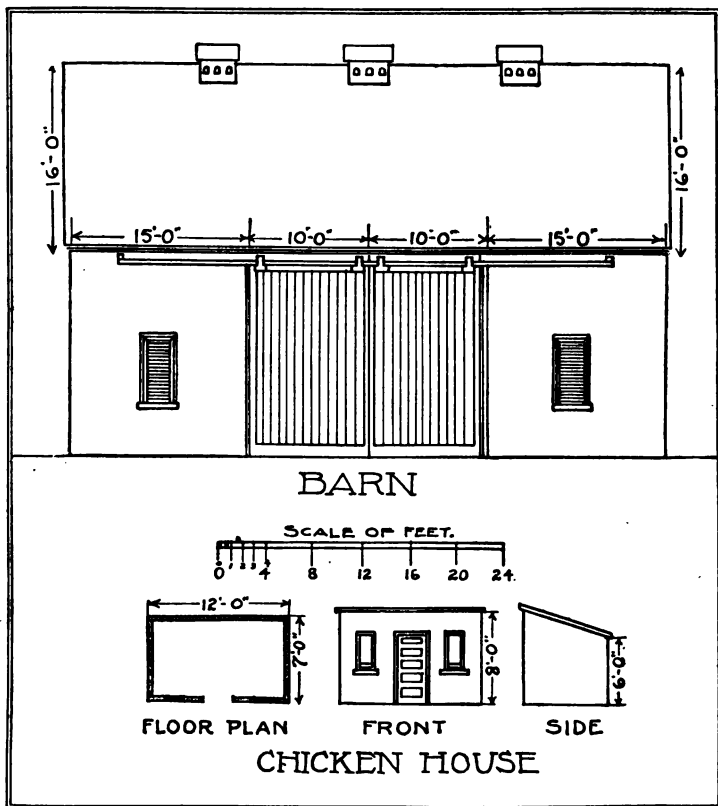
49. The handle is made from a piece $\frac{1}{4} \times 3 \times 1'$. How many board feet of lumber will a class of 24 need for this box, adding 1 ft. to every 10 ft. for waste?

50. If the lumber costs \$100 per M, what is the cost of the material for each box, to the nearest cent?

51. If the lumber costs 10% more than in Ex. 50 but a discount of 10% for cash is allowed, find the cost of the material for each box.

DRAWING TO SCALE

1. Measure this drawing with your ruler. Tell the scale by stating how many feet are represented by 1 in.



2. Test the floor plan of the chicken house to see if the scale is correct ; then the front ; then the end.

3. Make a copy of the plan on a scale of 8 ft. to 1 in.
4. According to the scale, what is the length of the barn floor? the width of the windows?
5. How high is the ridge of the roof above the eaves of the roof?

NOTE. The dimension 16 ft. does not indicate the slant of the roof, but the actual height of the ridge above the eaves.

6. If the barn is 40 ft. wide and 17 ft. high to the eaves, how many square feet of siding does it take for the sides and ends, not allowing for any openings? (For area of triangular gables, see p. 241.)

7. Show by a drawing the gable ends of this barn if there are two windows 4 ft. \times 7 ft., each 12 ft. from the side of the barn and 8 ft. from the bottom.

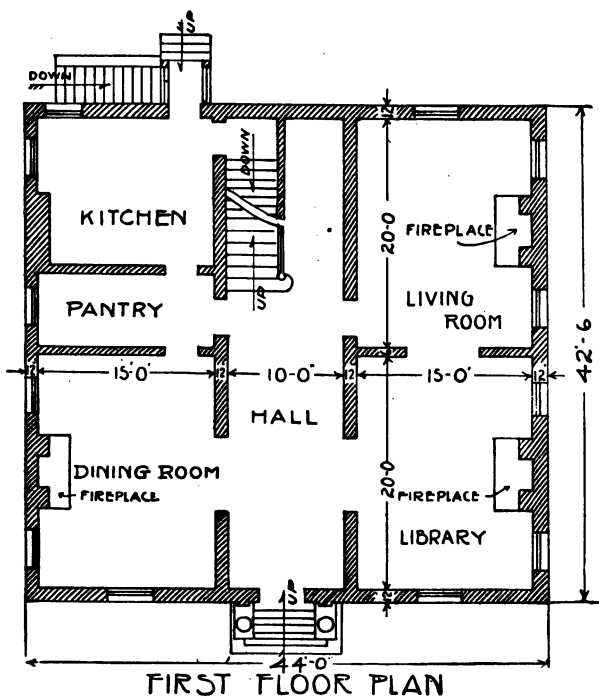
8. Find the cost of painting the sides and the gable ends of this barn at 40¢ a square yard, not allowing for openings. (Do not include the roof.)

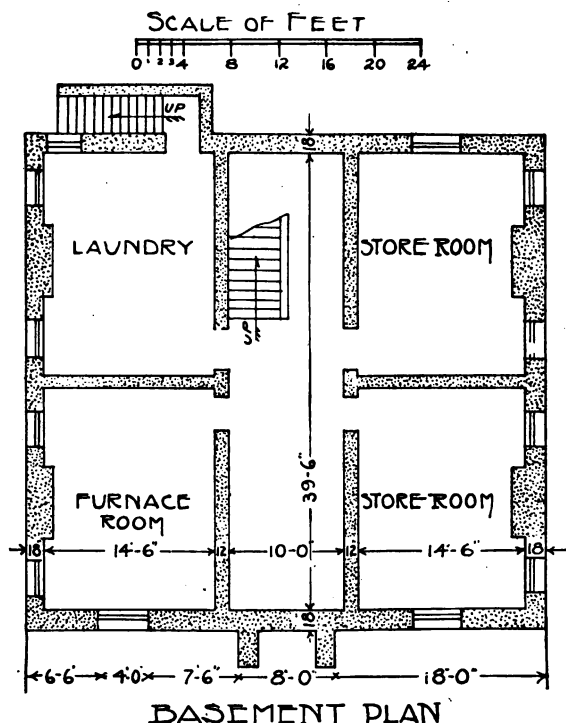
9. Make a drawing for the plan of a chicken house, three times the length of the one on p. 120, and having three doors and six windows of the size shown, and two partitions.

10. Make a drawing to show a plan of a wagon shed 24 ft. wide by 36 ft. long. The shed is to be 16 ft. to the roof, and the ridge of the roof is to be 10 ft. higher than the eaves of the roof.

Mr. Smith gets from the architect the plans on pp. 122 and 123 of the cellar, first floor, and front elevation of his house. Find from the scale the dimensions of the rooms, the windows, and the doors.

11. Make a copy of the plan of this house on a scale of 8 ft. to 1 in.





12. Find the width and the length of the pantry, the fireplaces, and the openings from the hall into each room; the height of the house to the eaves; the space between the windows; the space each window is from the end of the house; the height of the chimney tops from the eaves; and the height of the ridge of the roof from the eaves.

13. Make a drawing on a suitable scale to show the cellar plans, first floor, and elevation for a house 40' by 50', carrying out the design of the plans in this picture.

14. Make a drawing to show the front elevation of the house in which you live.

15. A city lot has a house with a gable fronting the street. The house is 24' \times 42'. Draw a plan, on a suitable scale, to show a first floor and a hallway with a stairway on the side; a parlor with a fireplace; a dining room with a fireplace; and a kitchen 10' by 16' back of the front hall. Also draw the front elevation of the gable end, showing a 4' door and a 5' window on the first floor, two 4' windows on the second floor, and the ridge of the roof 12' above the eaves.

16. Make drawings to show the plan and the side elevation of your schoolroom, if in the country; or of some building of simple design, if in the city.

17. Make simple drawings to show (a) a barn 40' long and 30' high, with a 16-foot doorway, the ridge of the roof being 12' above the eaves; (b) the cellar and first-floor plans and front elevation of a house of simple design; (c) a chicken house of simple design.

18. Make a plan of the front of some near-by store, showing the window and door spacing.

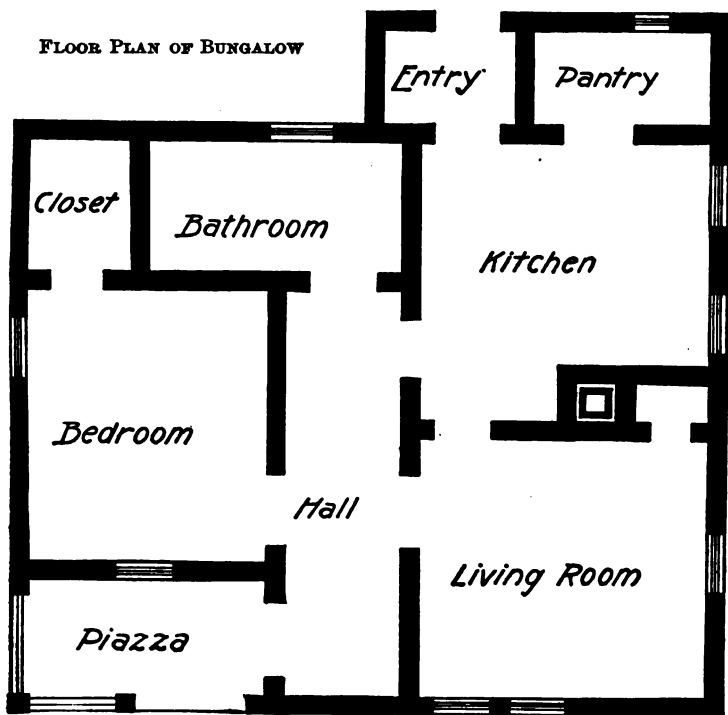
19. Make a plan of the first floor of a barn 30' by 36' with a row of 5 stalls 6' by 12', backed by a five-foot passageway on one side, the other side of the floor being occupied by a feed and harness room. Show a sliding door at one end, 10' in width.

20. A cellar wall is 24' by 40' with an extension on one side 12' by 16'. The walls are $1\frac{1}{2}$ ' thick. Make a drawing, on a scale of 1' to $\frac{1}{4}$ ", showing an outside door 3' wide.

21. Make a drawing, on a scale of 8' to 1", to show the dimensions of your classroom, of each pupil's desk, and of each blackboard.

WORKING DRAWINGS

1. The bungalow represented in the plan is 29 ft. wide at the widest end and 30 ft. long. On how wide a lot must it be built so that it may be 6 ft. from one side of the lot and have a 12-foot space for a driveway on the other side?



SCALE 1 FOOT TO $\frac{1}{4}$ INCH

2. If the bungalow stands 20 ft. from the front line of a lot 125 ft. deep, what will be the depth of the yard?

3. At 18¢ a foot find the cost of picture molding around the four walls of the living room, $10\frac{1}{2}$ ft. by 12 ft.

4. How much will it cost to floor the hall, 5 ft. by 17 ft. and the bedroom, $10\frac{1}{2}$ ft. by $11\frac{1}{2}$ ft., with 1-inch flooring, at \$65 a thousand board feet, adding $\frac{1}{8}$ for waste?

5. What will be the cost of linoleum for the floor of the kitchen, $11\frac{1}{2}$ ft. by 12 ft., making no allowance for the chimney, at 96¢ a square yard?

6. What will be the cost of linoleum for the floor of the pantry, 4 ft. by 7 ft., at 96¢ a square yard?

7. What are the dimensions of the top of this blacking case?

8. What are the dimensions of each side?

9. What are the dimensions of each end?

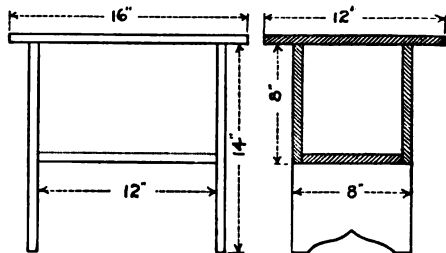
10. What are the dimensions of the bottom?

11. If the top is cut from a 12" board and the other pieces from an 8" board 1" thick, how much will the material for a class of 20 cost at \$81 per M? What is the cost for material for a box?

12. Reckoning a boy's time at 25¢ an hour, how much will the labor on the box be worth if the boy works from 1.15 P.M. to 2.45 P.M. the first day; from 1.20 P.M. to 3 P.M. the second day; and from 2.10 P.M. to 3.40 P.M. the third day?

13. What will be the cost of this blacking case, to the nearest cent, including labor and material?

14. Each child in a class of 32 makes such a blacking case. Reckoning the cost of material and labor as in Ex. 13, what is the total profit made by the class when the 32 cases are sold at \$2.75 apiece?

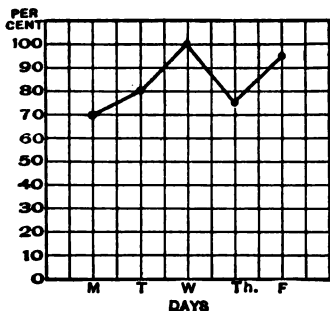


GRAPHS

Very often we can get a quicker or a more vivid impression of relative values by means of a picture or a diagram than by the numbers which it represents. Such a diagram is called a **graph**.



Records and statistics are represented also by line graphs, by bars, by circles, and in other ways.



4. This graph shows David's weekly record in spelling tests. On Monday he had 70 %; on Tuesday, 80 %; on Wednesday, 100 %; on Thursday, 75 %; and on Friday, 95 %. What was his average for the week?

Represent the following records by graphs on cross-ruled paper.

5. Margaret's averages in arithmetic were as follows: Sept., 80 %, Oct., 75 %, Nov., 90 %, Dec., 95 %, Jan., 85 %.

6. John's averages in geography were as follows: Feb., 65 %, March, 70 %, April, 80 %, May, 90 %, June, 100 %.

7. From the following diagram tell the prices per hundredweight of cattle in each year from 1903 to 1917.

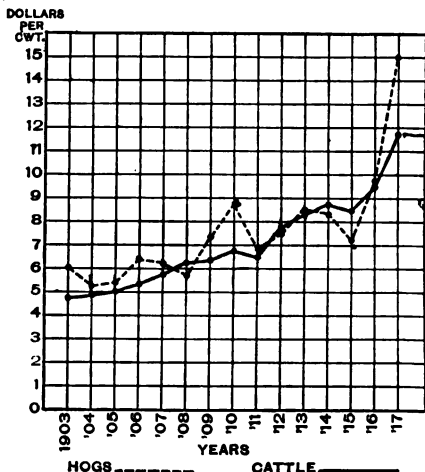
8. Tell the prices per hundredweight of hogs in each year from 1903 to 1917.

9. What was the year of highest value for the hogs? for the cattle?

10. In what year did hogs show the greatest decrease in value from the preceding year? (Notice the longest downward broken line.)

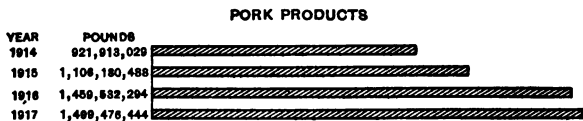
11. In what year did cattle show the greatest increase?

12. What was the per cent of increase in the price of hogs from 1903 to 1917?



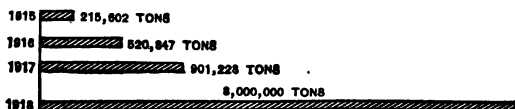
Each of these circles represents a dollar. The black portion shows the part of a dollar necessary to buy an equal amount of food values. That is, it takes \$.10 to buy a certain quantity of milk; \$.13 to buy the same food value in mutton; etc. Therefore an equal quantity of food value in mutton costs $\frac{13}{100}$ or 130 % of that in milk.

13. Find in the same way, in comparison with milk, the per cent of cost for an equal value of ham; of beef; of eggs; of codfish.



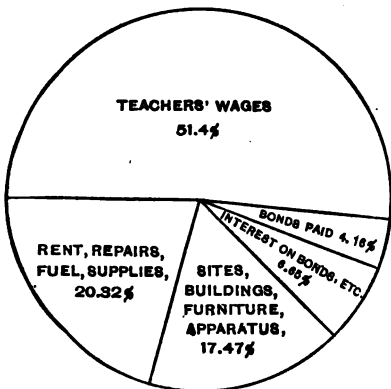
EXPORTS OF PORK PRODUCTS FROM THE UNITED STATES

14. Find, to the nearest tenth per cent, what per cent of the 1914 exports were exported in 1915; in 1916; in 1917.



INCREASE IN GROSS TONNAGE OF SHIPS CONSTRUCTED IN THE U. S. SHIPYARDS

Notice that the numbers in the graph show that the shipping tonnage in 1916 was $\frac{520847}{216802}$, or 241%, of that in 1915. The 1916 bar should therefore be about $2\frac{1}{2}$ times the 1915 bar or $2\frac{1}{2} \times \frac{8}{16}$. Measure it to see whether it is right.



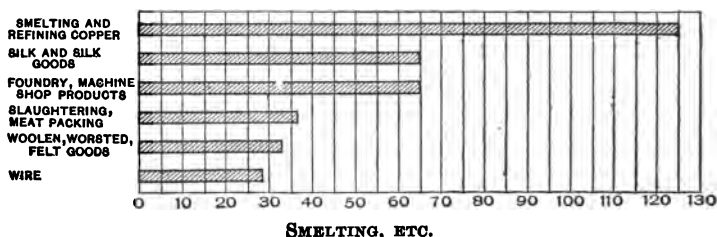
SCHOOL EXPENSES

15. What per cent of the 1915 tonnage is the 1917 tonnage? the 1918 tonnage?

16. This graph represents the distribution of \$13,649,000 spent for school purposes in a western state. Find how much was spent for each purpose.

17. Draw a bar graph like those on p. 129 to represent the facts of Ex. 16.

The following is a graph showing the relative values one year of the products of the most important manufacturing industries of a certain state.



The shaded strips indicate the number of million dollars' worth of the products of these manufactures. Each vertical division represents five million dollars of product.

18. What was the approximate value of each industry?

19. How much greater in value was the production of the first three industries than of the last three?

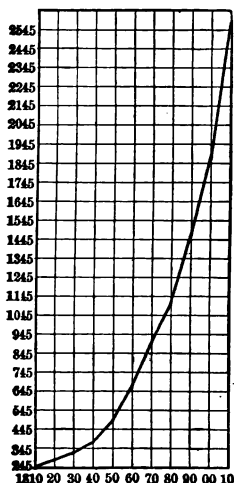
20. Represent graphically the area of each of the New England States; of the Middle Atlantic States; of the South Atlantic States; of the South Central States; of the North Central States; of the Mountain States; of the Pacific States.

21. Represent graphically the area of the United States from 1850 to 1919: 1850,—2,997,119; 1900,—3,804,600; 1919,—3,805,212.

22. In 1914 the United States produced 891,017,000 bu. wheat; in 1915, 1,025,801,000 bu.; in 1916, 689,886,000 bu.; in 1917, 659,797,000 bu.; and in 1918, 918,920,000 bu. Represent this graphically.

23. Draw a graph to show that in 1880 there were 93,267 mi. of railroad in the United States; in 1890, 167,191 mi.; in 1900, 198,264 mi.; and in 1915, 264,378 mi.

The following graph illustrates the growth in thousands of the population of a state by decades for one hundred years.



Each vertical division represents a decade, and each horizontal division, a growth in population of 100,000. For example, between 1810 and 1820, the growth was less than 50,000, while between 1850 and 1860, the growth was approximately 200,000.

24. In what decade was the growth greatest?

25. In what decades was the increase less than 100,000?

26. Show by a curve or a broken line the increase in the size of the graduating class in a high school whose graduating classes numbered as follows: 1913,—35; 1914,—38; 1915,—37; 1916,—41; 1917,—47; 1918,—52; 1919,—60.

27. Trace a curve for the attendance of a school as follows: September, 775; October, 815; November, 800; December, 795; January, 790; February, 780; March, 790; April, 800; May, 785; June, 770.

28. Trace a curve to illustrate the following changes in temperature for a certain day: 7 A.M., 40°; 9 A.M., 42°; 11 A.M., 46°; 1 P.M., 50°; 3 P.M., 53°; 5 P.M., 49°; 7 P.M., 46°.

29. Trace the curve of maximum temperature for a week as follows: Monday, maximum temperature, 29°; Tuesday, 35°; Wednesday, 43°; Thursday, 27°; Friday, 24°; Saturday, 30°; Sunday, 43°.

HOUSEHOLD MEASUREMENTS

PAPERING

The unit of measure in wall paper is the **single roll**, which is 8 yd. in length and usually 18 in. in width. A **double roll** is 16 yd. in length.

Fractional parts of a roll are not sold. Allowance is usually made for openings. Border is sold by the linear yard.

As the paper is $\frac{1}{2}$ yd. wide, the number of vertical strips required is twice the number of yards in the perimeter of the room.

The number of rolls needed is the quotient of the number of strips by the number that can be cut from a roll.

1. At \$.30 a yard find the cost of the border for a room 15 ft. by 18 ft.

2. How many single rolls of plain paper are needed for the walls of a room 18 ft. by 21 ft. and 8 ft. high, without allowances?

SOLUTION. $(2 \times 18 \text{ ft.}) + (2 \times 21 \text{ ft.}) = 78 \text{ ft.} = 26 \text{ yd.}$ $2 \times 26 \text{ strips} = 52 \text{ strips.}$ $8 \text{ yd.} = 24 \text{ ft.}$ $24 \text{ ft.} \div 8 \text{ ft.} = 3$, number of strips that can be cut from a roll. $52 \text{ strips} \div 3 \text{ strips} = 17\frac{1}{3}$; 18 rolls are needed.

3. Find the cost of the paper in Ex. 2 at \$.45 a roll.

4. At \$.50 a roll find the cost of papering a bedroom 15 ft. by 18 ft. and $7\frac{1}{2}$ ft. high, allowing 12 strips for openings.

5. Find the cost of papering a room 12 ft. by 13 ft. and $7\frac{1}{2}$ ft. high, with paper at \$.35 a roll, allowing 6 strips for openings.

Find the cost, at \$.40 a roll, of papering the walls of the following rooms:

	WIDTH	LENGTH	HEIGHT	ALLOWANCE
6. Parlor	18 ft.	24 ft.	8 ft.	20 strips
7. Library	17 ft.	20 ft.	$7\frac{1}{2}$ ft.	10 strips
8. Dining room	18 ft.	20 ft.	$7\frac{3}{4}$ ft.	14 strips
9. Bedroom	12 ft.	15 ft.	8 ft.	12 strips

CARPETING

Carpet, matting, and border are sold by the **linear yard**. Oilcloth and linoleum are sold by the linear yard or by the **square yard**. Ingrain carpets are usually 1 yard wide; other carpets are generally 27 in., or $\frac{3}{4}$ yd., wide.

Allowance must be made for loss in matching strips of carpet containing a design.

1. Find the number of strips (*a*) of plain carpet 1 yd. wide, (*b*) of plain carpet $\frac{3}{4}$ yd. wide, needed for rooms of the following widths: 15 ft., 18 ft., 20 ft., 24 ft., $13\frac{1}{2}$ ft.

2. If a room is 14 ft. wide and 18 ft. long, why is it better to lay a carpet $\frac{3}{4}$ yd. wide crosswise? How many yards of plain carpet are needed?

SOLUTION. (*a*) $18 \text{ ft.} = 6 \text{ yd.}$; $6 \text{ yd.} \div \frac{3}{4} \text{ yd.} = 8$, number of strips crosswise (no waste).

$14 \text{ ft.} = \text{length of each strip}$; $8 \times 14 \text{ ft.} = 112 \text{ ft.} = 37\frac{1}{2} \text{ yd.}$

(*b*) $14 \text{ ft.} = 1\frac{1}{2} \text{ yd.}$; $1\frac{1}{2} \text{ yd.} \div \frac{3}{4} \text{ yd.} = 6\frac{1}{2}$. Therefore 7 strips are needed ($\frac{1}{2}$ strip wasted).

$18 \text{ ft., or } 6 \text{ yd.} = \text{length of each strip.}$ $7 \times 6 \text{ yd.} = 42 \text{ yd.}$

3. Which is the better way to lay a plain carpet 1 yd. wide on the floor of a room 18 ft. wide and 20 ft. long? How many yards are needed?

4. At \$1.50 a yard, how much does it cost to carpet a room 12 ft. wide and 21 ft. long with carpet 1 yd. wide laid lengthwise?

How many yards of plain carpet 1 yd. wide (laid in the most economical way) are needed for a floor:

5. 15 ft. \times 21 ft. 7. 15 ft. \times 27 ft. 9. 12 ft. by 18 ft.

6. 18 ft. \times 22 ft. 8. 18 ft. \times 21 ft. 10. $14\frac{1}{2}$ ft. by 18 ft.

11. Find the cost of covering a kitchen 12 ft. by $13\frac{1}{2}$ ft. with linoleum 4 yd. wide, at \$1.60 a yard, if the linoleum is laid the long way of the room.



PLASTERING AND PAINTING

In plastering, painting, and kalsomining, the unit of measure is the **square yard**.

NOTE. In some localities an allowance is made for openings and baseboards, but there is no uniform rule in practice. Any allowance should always be specified in the contract.

There are either 50 or 100 laths in a **bundle**. A bundle of 100 is generally estimated to cover 5 square yards of surface.

Written Work

1. How many square yards of plaster are necessary to cover the ceiling of your classroom?
2. Find the cost of painting both sides of a tight board fence 150 ft. long and 8 ft. high, at 35¢ a square yard.
3. Allowing nothing for openings, how much will it cost to kalsomine the walls and the ceiling of a room 16 ft. wide, 20 ft. long, and 12 ft. high, at 20¢ a square yard?
4. A storeroom is 20 ft. wide, 75 ft. long, and 15 ft. from floor to ceiling. How many bundles of laths, each containing 100, are required for the sides, ends, and ceiling, making an allowance of 50 sq. ft. for openings?

5. How much will it cost to plaster the walls and the ceiling of a storeroom, 18 ft. by 40 ft. and 12 ft. high, at 12¢ a square yard for lathing, and 34¢ a square yard for plastering, deducting 80 sq. ft. for openings?

6. A building 24 ft. by 90 ft. contains 3 stories, each 13 ft. high. The first story is plastered on the sides and the rear and the other stories on all four sides. In the second story and in the third story there are 3 windows in the front, each $3\frac{1}{2}$ ft. by 8 ft., and 2 windows in the rear, each 3 ft. by 8 ft. If the ceilings are sheet iron, find the cost of the plastering, at 33¢ a square yard, deducting for all openings.

7. In modern business buildings, metal laths are used. Estimate the cost of metal laths for the building in example 6, at 25¢ a square yard.

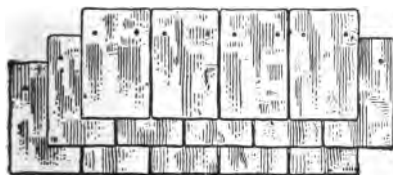
ROOFING AND FLOORING

In roofing, tiling, and flooring, the unit of measure is the square of 100 square feet.

Written Work

1. Each of the two slopes of a roof is 20 ft. long and 60 ft. wide. Find the cost of covering them with tar paper at \$8.60 a square.

2. The floor of a hallway 12 ft. by 30 ft. is inlaid with 2-inch square tile. Find the number necessary.



In roofing with slate, each course of slate is partly overlapped. Each slate as here shown is 10 in. by 16 in. and has 4 in. exposed to the weather.

3. How many square inches of each slate are exposed?
4. If a 10-inch by 16-inch slate is exposed 4 in. to the weather, find the number of slates necessary to lay a square (10 ft. by 10 ft.).
5. If slate 10 in. by 16 in. is laid 6 in. to the weather, find the number necessary to lay a square. Find the weight of a square of slate at $4\frac{1}{2}$ lb. a square foot.
6. Each slope of a roof is 20 ft. by 40 ft. Find the number of slates, 10 in. by 16 in., exposed 4 in. to the weather, required for this roof, allowing nothing for breakage. Find the cost of the slates at \$7.50 a square.

There are 250 shingles in a bunch.

Shingles average 16 in. in length and 4 in. in width. The exposed surface of a shingle laid $4\frac{1}{2}$ in. to the weather is, therefore, 18 sq. in. Without waste 8 shingles will lay 1 sq. ft., and 800 shingles will lay 100 sq. ft. or 1 square. Allowing for waste, 4 bunches, or 1000 shingles, are estimated to lay a square.

7. Allowing nothing for waste, how many bunches of shingles are required to cover a barn roof 35 ft. in width on each side and 70 ft. in length. Find the cost at \$1.00 a bunch.

8. A roof has 14 squares. Allowing for waste, find the cost of the shingles for it, at \$2.25 a bunch.

Flooring is frequently estimated by the *square*.

9. How much will it cost, at \$7.00 a square, to lay the floor of a hall 30 ft. by 60 ft., adding $\frac{1}{6}$ for waste?

10. Estimate the number of squares of flooring required for two floors of a storeroom 25 ft. by 60 ft.

STANDARD TIME

Pennsylvania Railroad			
Mi.			
0	New York	lve.	11.04
91.7	Philadelphia	"	1.11
440.5	Pittsburgh	"	9.45
615.7	Mansfield, Ohio { E. T.	{ arr.	2.23
908.9	Chicago { C. T.	{ lve.	1.28
		arr.	8.54
Union Pacific Railroad			
Mi.			
0	Chicago	lve.	10.80
491	Omaha	"	1.20
772	North Platte . . { C. T.	{ arr.	9.40
998	Cheyenne { M. T.	{ lve.	9.00
		arr.	4.35

This is a condensed time-table of the trains John took on his way from the city of New York, to visit his uncle in Cheyenne, Wyoming. The light-faced figures indicate A.M. time and the black-faced figures P.M. time.

John started at 11.04 A.M., Monday. He arrived at

Mansfield, Ohio, at 2.28 A.M., Tuesday; but as the time changed there from Eastern to Central time, he left at 1.28 A.M. and had to set his watch *backward* one hour. At 8.54 A.M. Tuesday he arrived at Chicago and changed cars. On Wednesday morning, as he was leaving North Platte (where the train stopped for 20 minutes) he noticed that by his watch it was 10 A.M. while the station clock showed 9 A.M.; so he set his watch *backward* another hour. On his return trip *eastward* to New York John set his watch *forward* at the same places where he had set it *backward* on his *westward* trip. Let us now learn the reason why he had to change his watch to make it agree with the clock time of the places which he passed.

As the earth rotates on its axis 360° every 24 hours, every place on its surface passes through 360° in 24 hours or through 15° in 1 hour. This makes the sun appear to pass through 15° in 1 hour. As the sun appears to move from east to west, it is 1 hour *later* than our sun time at any point 15° *east* of us, and 1 hour *earlier* at any point 15° *west* of us.

In 1883 the railroads of the United States agreed upon a system of **standard time**. The country is divided into four **time belts** each about 15° in width. Each belt extends about $7\frac{1}{2}^{\circ}$ east or west of a meridian and the difference in time between two adjoining belts is exactly *one hour*.

The time of the meridian 75° W. of Greenwich is called **Eastern Time (E. T.)**; the time of the meridian 90° W., **Central Time (C. T.)**; of 105° W. **Mountain Time (M. T.)** and of 120° W. **Pacific Time (P. T.)**.

When it is noon by E. T. it is 11 A.M. by C. T., 10 A.M. by M. T., 9 A.M. by P. T. Similarly, when it is noon by P. T., it is 1 P.M. by M. T., 2 P.M. by C. T., 3 P.M. by E. T.

The time-tables of the various railroads indicate the places at which they change their time. Notice in the time-table on page 137 that the time of arrival at Mansfield, Ohio, is given in E. T., 2.28 A.M. and the time of departure in C. T., 1.28 A.M. (This train did not stop at Mansfield.) The time in any belt is 1 hour *faster* than the time in the belt west of it, or 1 hour *slower* than the time in the belt east of it.



1. In traveling from New York to California, how often must you change your watch and how? How must you change it in traveling from California to New York?

2. When it is noon by C. T., what time is it by E. T.? by M. T.? by P. T.?

3. When it is 9 A.M. by M. T., what time is it by P. T.? by E. T.? by C. T.?

4. When it is midnight by P. T., what time is it by C. T.? by M. T.? by E. T.?

5. When it is 8 A.M. in Maine, what time is it in Iowa? in Colorado? in Oregon?

6. When it is 11 A.M. in California, what time is it in Delaware? in Indiana? in Wyoming?

7. When it is 3.30 P.M. in St. Louis, what time is it in New York? in Seattle? in Omaha? in Denver?

8. When it is 6.15 A.M. in Chicago, what time is it in Washington, D. C.? in Atlanta? in Portland, Oregon?

9. When it is midnight in Seattle, what time is it in Salt Lake City? in St. Louis? in New York?

10. In the time-table on page 137 the train arrives at North Platte at 9.40 A.M. (C. T.) and leaves at 9.00 A.M. (M. T.). How long does the train stop at North Platte?

11. What is the difference in time between the closing of the election polls at 7 P.M. in New York and 7 P.M. in Seattle, on the day for choosing presidential electors?

12. At what time will a telegram sent from Philadelphia at 11 A.M. reach Seattle, allowing 2 hr. for transmission?

13. At what time will a telegram sent from Chicago at 11.45 P.M. reach Boston, allowing 2 hr. for transmission?

14. When it is 9 A.M. in New York, what time is it in Philadelphia? in Cincinnati? in San Francisco?

RATIO AND PROPORTION

RATIO

1. The quotient of $30 \div 10$ is 3. Compare 30 with 3 in such a way as to show how many times 3 is contained in 30. What, then, is the relation of 30 to 3?

The relation of two numbers of the same kind as expressed by the quotient of the first divided by the second is called **ratio**.

2. What is the ratio of 10 to 8? of 12 to 4? of 3 to 6? of 2 yd. to 8 yd.? of \$12 to \$3?

Since the division of two numbers of the same kind gives an *abstract quotient*, all ratios are *abstract*.

The **sign** of ratio is a colon (:) placed between the numbers. Thus, the ratio of 12 to 3 is written 12:3. It is read, "the ratio of 12 to 3." It may be written also $12 \div 3$ or $\frac{12}{3}$.

The numbers compared are called the **terms** of a ratio. The first is the **antecedent**; the second is the **consequent**.

$$12:6 = \frac{\text{antecedent}}{\text{consequent}} = 12 \div 6 = \frac{\text{dividend}}{\text{divisor}} = \frac{12}{6} = \frac{\text{numerator}}{\text{denominator}}.$$

Since the antecedent of a ratio may be regarded as the numerator, and the consequent as the denominator of a fraction, *both terms of a ratio may be multiplied or divided by the same number without changing the value of the ratio.*

Find the ratio of:

- | | | | |
|-------------|--------------|------------------------|------------------------------------|
| 3. 10 to 5 | 8. 18 to 9 | 13. 40 to 10 | 18. $\frac{2}{3}$ to $\frac{1}{3}$ |
| 4. 5 to 15 | 9. 27 to 9 | 14. 8 to 24 | 19. $\frac{5}{8}$ to $\frac{1}{8}$ |
| 5. 8 to 2 | 10. 35 to 5 | 15. 2 to $\frac{1}{2}$ | 20. 4 to $\frac{1}{4}$ |
| 6. 25 to 50 | 11. 16 to 48 | 16. 24 to 8 | 21. $\frac{3}{4}$ to $\frac{1}{4}$ |
| 7. 50 to 25 | 12. 48 to 16 | 17. 8 to 24 | 22. $\frac{1}{10}$ to 1 |

Written Work

Find the value of the following ratios :

1. $125 : 25$

5. $\frac{2}{3}$ to $\frac{1}{12}$

9. \$225 to \$2.25

2. $6.25 : 25$

6. 6.4 to 16

10. 3 yd. to 3 ft.

3. $\frac{3}{4}$ to $\frac{1}{16}$

7. $37\frac{1}{2}$ to 200

11. 75% to $12\frac{1}{2}\%$

4. $\frac{1}{8}$ to $1\frac{1}{2}$

8. $62\frac{1}{2}$ to 500

12. 1 mi. to 1 rd.

SIMPLE PROPORTION

An equality of ratios is called a proportion. Proportion is generally indicated by the equality sign. Thus, $12 : 6 = 8 : 4$, or $1\frac{2}{3} = \frac{2}{3}$.

A proportion may be read in two ways. Thus, $12 : 6 = 8 : 4$ is read "The ratio of 12 to 6 is equal to the ratio of 8 to 4," or "12 is to 6 as 8 is to 4."

The *first* and *the fourth* terms of a proportion are called the **extremes** and the *second* and the *third terms*, the **means**.

In $15 : 5 = 12 : 4$, the extremes are 15 and 4; the means, 5 and 12.

Find the product of the means; then the product of the extremes in each example :

1. $8 : 4 = 10 : 5$

3. $24 : 4 = 36 : 6$

5. $\frac{2}{3} = \frac{8}{9}$

2. $15 : 3 = 30 : 6$

4. $\frac{3}{8} = \frac{6}{16}$

6. $\frac{1}{5} = \frac{3}{15}$

Observe how the product of the extremes in each proportion compares with the product of the means.

In every proportion the product of the means is equal to the product of the extremes.

If one of the extremes is missing, divide the product of the means by the given extreme. If one of the means is missing, divide the product of the extremes by the given mean.

Written Work

Find the value of the unknown term :

1. $36 : 6 = 24 : ?$

2. $15 : 25 = ? : 40$

SOLUTION. $\frac{36 \times 24}{6} = 4.$

SOLUTION. $\frac{15 \times 40}{25} = 24.$

3. $60 : 15 = 75 : ?$

8. $\frac{3}{5} : \frac{2}{3} = 9 : ?$

4. $75 : ? = 90 : 18$

9. $\frac{5}{8} : ? = 25 : 8$

5. $40 : ? = 72 : 18$

10. $7.5 : 1.5 = 2.5 : ?$

6. $? : 30 = 8 : 48$

11. $6.25 : 2.5 = ? : 1$

7. $? : 45 = 7 : 63$

12. $60 : 150 = 36 : ?$

NOTE. See also page 217.

13. If 8 lamps cost \$48, how much do 20 lamps cost?

Since *ratio* is the relation of two similar numbers, 8 lamps and 20 lamps form one ratio, and \$48 and the answer, the other ratio.

Write as the second ratio 48 : ? Since 20 lamps cost *more* than 8 lamps, the answer represents a *larger* sum than \$48. Therefore, as the larger number is the consequent of the second ratio, the larger number must be made the consequent of the first ratio. The proportion, therefore, is:

$$8 : 20 = 48 : ? \quad \frac{20 \times 48}{8} = 120; \text{ Ans. } \$120$$

14. How much will 30 dozen eggs cost when 70 dozen cost \$42?

15. When potatoes are 5 lb. for 17¢, how much should a bushel of 60 lb. cost?

16. If 25 men can build a bridge in 18 days, how long, at the same rate, will it take 15 men to build it? (Notice that fewer men require more time. $15 : 25 = 18 : ?$)

17. It is estimated that 90 men are necessary to grade a certain street in 45 days. If only 81 men are hired to do the work, how long will it take them?

18. It costs \$1.50 to clean a rug 9 ft. \times 6 ft. At the same rate, how much will it cost to clean a rug 9 ft. \times 8 ft.?

19. A bankrupt's debts are \$32,000, and his assets are \$10,000. How much will be paid on a claim of \$6150?

20. Which is cheaper, a can of corn containing 1 lb. $2\frac{1}{2}$ oz. ($18\frac{1}{2}$ oz.) for $12\frac{1}{2}\phi$, or 1 lb. 5 oz. (21 oz.) for 15ϕ ?

SUGGESTION. To find how much the larger can would cost at the rate of the smaller can, solve the proportion $18\frac{1}{2} : 21 = 12\frac{1}{2} : ?$

21. A bakery sells 5ϕ loaves weighing 16 oz. when flour is \$6 a barrel. What size loaves should it sell at 5ϕ when flour is \$10.50 a barrel? (Omit fraction of an ounce.)

22. A map is drawn on a scale of 100 miles to $\frac{3}{4}$ of an inch. What distance is represented on the map by $\frac{5}{16}$ of an inch?

PARTITIVE PROPORTION

The process of separating a number into parts proportional to two or more numbers is called **partitive proportion**.

Written Work

1. Separate 180 into parts proportional to 1, 2, and 3.

SOLUTION. Since the parts are in the ratio of 1, 2, and 3, then $(1 + 2 + 3)$ parts or 6 parts = 180.

The first number = $\frac{1}{6}$ of 180, or 30

The second number = $\frac{2}{6}$ of 180, or 60

The third number = $\frac{3}{6}$ of 180, or 90

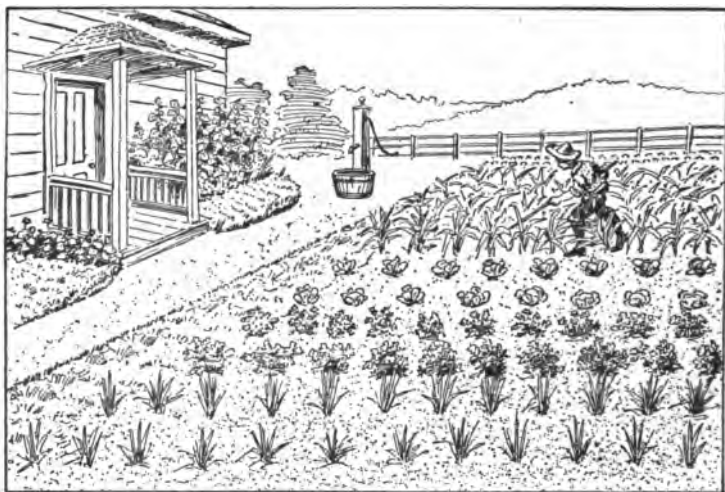
Test. $30 + 60 + 90 = 180$; $30 : 60 : 90 = 1 : 2 : 3$.

2. A man and two boys earn \$160 and agree to divide it as follows: 5 parts to the man, 2 parts to the first boy, and 1 part to the second boy. How much should each receive?

3. The receipts of a street railway in one month are \$15,600, and the expenses are to the profits as 1 to 2. Find the expenses and the profits.

EVERYDAY USE OF NUMBERS

Market Gardening



NOTE. The planting, in Ex. 1-11, is begun 2 ft. from the edge.

1. This plot is 100' by 300'. James planted the entire length of the plot in 10 rows of sweet corn, each 2 ft. apart. The grains were planted 8 in. apart. Estimating an average of one ear to a grain, about how many ears of sweet corn did he raise?

2. James sold the sweet corn at 25¢ a dozen ears. How much did he receive for 4450 ears?

3. James planted 2 rows of cabbage, each 2 ft. apart, the length of the plot. He set the cabbage plants 18 in. apart in the row. How many dozen plants did he plant?

4. He sold the cabbages at 8¢ a pound. How much did he receive for 200 lb.?

5. James planted 2 rows, $2\frac{1}{2}$ ft. apart, in early potatoes. He raised $3\frac{3}{4}$ bu. potatoes (60 lb. each), which he retailed at 3¢ a pound. How much did he get for the potatoes?

6. James planted 3 rows, 14 in. apart, in mammoth onion seed. He raised 3 bu. onions (57 lb. each), which he retailed at 5¢ a pound. How much did he receive for the onions?

7. He planted 1 row, the length of the lot, in celery. How much did he get for 100 bunches at 12¢ a bunch?

8. He planted 1 row, the length of the lot, in peas, and 1 row in lima beans. He sold 156 lb. peas at 10¢ a pound and 125 lb. lima beans at 11¢ a pound. How much did he receive for them?

9. He planted 1 row in beets, which yielded 25 bunches. How much did he receive for them at 6¢ a bunch?

10. He cut the corn after taking off the ears, and sowed the ground in turnips. He sold 2 bu. (55 lb. each) of turnips at 5¢ a pound. How much did he receive for them?

11. He planted 2 doz. tomato plants, which yielded 156 lb. tomatoes. These he sold at an average of 8¢ a pound. For how much did he sell the tomatoes?

12. James paid for onion seed 25¢; for cabbage plants 50¢; for potatoes \$1.40; for tomato plants 40¢; for peas, beans, celery, turnips, and beets 10¢ each; for sweet corn 15¢; for fertilizer \$2.50; for sprays to kill cabbage worms and potato bugs 25¢; for plowing and harrowing \$1; for hose and hand cultivator \$3.75. Find his entire outlay.

13. James estimated his labor in caring for the garden and marketing as 20 days at \$1.50 a day. Make out his account January 1, 1919, showing the amount paid and for what it was paid, the amount realized and for what it was received. Find the balance

14. Ralph tested 125 kernels of corn and found that 84 % grew. How many kernels failed to grow?

15. George found that 85 % of his seed corn used for planting germinated. His yield was 110 bu. an acre. What would have been his yield if all the seed had germinated?

16. A corn-club member raised 103 bu. of corn on an acre of land, at a cost of \$14. He sold the corn at \$1.40 a bushel. What per cent of profit did he make?

17. Clara raised 1077 lb. of tomatoes on $\frac{1}{10}$ acre at a cost of \$4.63. Her profit was \$27.68. What was the selling price per pound? What per cent of profit, to the nearest tenth per cent, did she make?

18. Find the per cent of profit made by Nora, who raised 4000 lb. of carrots at a cost of \$16 and a profit of \$63.80.

19. A cold frame 40 ft. \times 6 ft. was planted in lettuce. The plants were set 6 in. from the border line on all sides. Rows were 1 ft. apart running lengthwise; plants 6 in. apart. How many plants were there in the frame?

20. If $33\frac{1}{3}$ % of the 474 matured heads were sold for 78 ¢ a dozen, and the remainder for 48 ¢ a dozen, what amount of money did the cold frame yield?

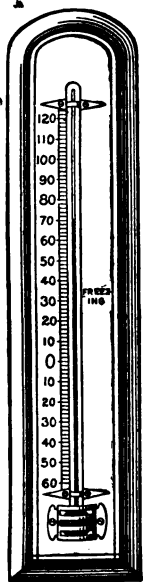
21. Deducting from \$22.91, \$1.25 for fertilizers and \$4.75 for labor, find what per cent was made on the cost of the frame, which was \$40.

22. Allowing 10 % a year for depreciation of the frame, what would be the yearly profit? What would be the net per cent of profit? (See Ex. 21.)

23. At the rate of \$22.91 for 240 sq. ft., what would be the total income from $\frac{1}{2}$ an acre inclosed in frames?

24. What would be the net profit on $\frac{1}{2}$ an acre at \$12.91 for 240 sq. ft.?

Measuring Heat



THERMOMETER

Temperature is measured by means of a **thermometer**. The picture at the left shows a Fahrenheit thermometer, the one commonly used in our country. Each space represents 2° . Notice that the freezing point of water is 32° above zero. The boiling point is 212° above zero, but for ordinary purposes the thermometer is not marked beyond 120° .

1. How many degrees below zero are marked on this thermometer? Temperatures below zero are written with a minus sign. Thus, -10° , -60° , etc.

NOTE. In scientific work the Centigrade thermometer is commonly used. The freezing point in the Centigrade thermometer is marked 0 and the boiling point 100. Each Centigrade degree is therefore $\frac{1}{180}$, or $\frac{5}{9}$, of a Fahrenheit degree.

1. At 6 A.M. the temperature was -5° F. and at 12 M. 20° F. Find the rise.

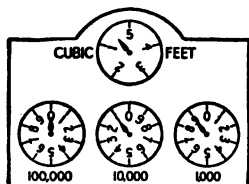
2. Find the fall in temperature from 20° F. to -2° .
3. How far below the freezing point is 10° F.? -10° F.?
4. How far above the freezing point is 112° F.?

What change in temperature took place:

- | | |
|--|--|
| 5. From 140° to -10° ? | 9. From $98\frac{1}{2}^{\circ}$ to $96\frac{1}{2}^{\circ}$? |
| 6. From 75° to $48\frac{1}{2}^{\circ}$? | 10. From -15° to $12\frac{1}{2}^{\circ}$? |
| 7. From -2° to 12° ? | 11. From 0° to 32° ? |
| 8. From $98\frac{1}{2}^{\circ}$ to 102° ? | 12. From -4° to 28° ? |

13. Make a graph to show the following temperatures for a week: Sunday, 80° ; Monday, 82° ; Tuesday, 90° ; Wednesday, 94° ; Thursday, 90° ; Friday, 85° ; Saturday, 83° .

Heating and Lighting



1. Find the cost of 19,000 cu. ft. of natural gas at 30¢ per 1000 cu. ft., less $2\frac{1}{2}\%$ discount.

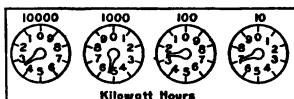
2. Find the cost of 3000 cu. ft. of artificial gas at 80¢ per 1000 cu. ft., less 10% discount.

3. A gas meter read 34,600 cu. ft. Jan. 1, and 46,700 cu. ft. Feb. 1. Find the amount of the bill at 30¢ per 1000 cu. ft., less 2% discount.

Electricity is measured by a unit called a **kilowatt hour** (K. W. H.). A kilowatt hour is the number of kilowatts of energy per hour.

A 16-candle-power electric lamp consumes 55 watts of electrical energy an hour and 10- and 8-candle-power electric lights consume, respectively, 40 and 32 watts an hour. A kilowatt equals 1000 watts.

4. If an electric meter on Feb. 1 read 352 K.W. H. and 66 K.W. H. were used in February, what was the reading on March 1? At 8¢ a kilowatt hour, find the cost of the electricity for February.



5. One month Mr. Fox used in his business 1600 K.W. H. electricity @ 10¢, less 10% for cash, 2000 cu. ft. of gas at 80¢ per 1000 cu. ft., and 6 T. 15 cwt. coal at \$9 a ton. Find his total for cash payments.

6. An electric light meter read: Dec. 1, 1636 K. W. H., Jan. 1, 1742 K. W. H. At 8¢ a kilowatt hour, find the cost of electricity for December. Find also the cost of lamp service at $\frac{1}{2}$ ¢ a kilowatt hour.

Farm Problems

1. A dairyman owns a cow that averages 3 gal. 2 qt. 1 pt. of milk daily. If he sells the milk at \$.071 a quart, how much will he realize from the cow during the month of May?



2. 600 bu. of apples from 40 unsprayed trees were sold as follows: 100 bu. of perfect fruit at \$2 a bushel, and 500 bu. of scabby and wormy fruit at \$1 a bushel. If 40 trees sprayed at \$.15 a tree yielded 500 bu. of perfect fruit @ \$2, and 100 bu. of wormy fruit @ \$1, how much was gained by spraying?

3. Find the number of pounds of butter each of the following cows produced one week as shown in the table:

NOTE. Butter fat is the richest part of milk from which butter is made. A 4 % milk contains 4 lb. of butter fat to every 100 lb. of milk.

	FLORA	BESS	QUEEN	DAISY
Pounds of milk	200	190	196	204
Per cent of butter fat	4.2	4.3	4.32	4

4. In 1919 the net profit on Mr. Hunt's farm was 12 % on a valuation of \$3000; in 1920, 10 $\frac{3}{4}$ % on \$3000. Find the profits for 2 yr.

5. Find the value of a grain binder that cost \$250 and has been used for 3 years, allowing 24 % for the total depreciation.

6. About 800 lb. of water are required to mature 1 lb. of corn. How many pounds of water are required to mature 1 acre of corn yielding 110 bu. ? (70 lb. = 1 bu. corn on cob.)

Farm Accounts

1. What were the total expenses of the following *dairy farm*? the total returns? the net profits?

2. What per cent of the investment was the profit?

INVENTORY¹

Land without buildings, 120 acres @ \$200	\$24,000.00
Water supply	100.00
Buildings:	
Dwelling	1,200.00
Barns	2,200.00
Other farm buildings	200.00
Live stock:	
20 cows @ \$80	\$1,600.00
Young cattle	596.00
50 hogs @ \$30	1,500.00
100 hens @ \$1	100.00
Teams and tools:	
4 horses @ \$250	\$1,000.00
Farm harness	75.00
Farm wagons	100.00
Corn harvester	175.00
Other farm implements	1,000.00
Binder	225.00

AVERAGE EXPENSES

Taxes	\$250.00
Help	850.00
Feeds	550.00
Supplies and incidentals	100.00

AVERAGE RETURNS

5000 lb. butter @ 48¢	\$2,400.00
8000 lb. hogs @ 20¢	1,600.00
Eggs	300.00
100 bu. potatoes @ \$1.50	150.00
Stock sold	1,250.00

¹ Adapted from "Farm Management," by Fred W. Card, published by Doubleday, Page and Company.

Poultry Problems

INCOME FROM A FLOCK OF 40 HENS,

MONTH	EGGS LAID	NUMBER OF DOZEN	AVERAGE PRICE PER DOZEN	VALUE OF EGGS
Jan.	608	?	\$.50	?
Feb.	675	?	.44	?
Mar.	774	?	.36	?
Apr.	625	?	.34	?
May	515	?	.35	?
June	525	?	.37	?
July	531	?	.40	?
Aug.	501	?	.45	?
Sept.	393	?	.48	?
Oct.	304	?	.53	?
Nov.	562	?	.60	?
Dec.	600	?	.52	?

1. Fill in the blanks in the above table.
2. Find the total number of eggs laid during the year, the number of dozen, and the total value.
3. The total cost of feed and labor was \$100. What was the average cost per hen?
4. What was the total net profit?
5. What was the average profit per hen?

NUMBER OF FOWLS, 100

Feed cost per fowl	\$.754
Labor cost per fowl	\$.456
Eggs produced	12,048
Average price per dozen	\$.485
Value of eggs	\$486.94

6. What was the average number of eggs per fowl and their value?
7. What was the difference between the average value of the eggs for each fowl and the cost of the feed and the labor for each fowl?
8. Find the per cent of net income from each fowl in the flock, the cost being \$1.21 for each fowl.

The Family Budget

A family consisting of a mother and four children had an income of \$100 a month. Their monthly expenses were :

Rent, \$16.50	Fuel and light, \$ 3.25	Sundries, \$5.00
Food, 48.00	Clothing, 15.00	Car fares, 3.60

1. How much could this family save in a month?
2. What per cent of the income was paid for each item?
3. Mr. Allen had an income of \$1440 a year. He spent 30 % of this for food ; 20 % for rent and repairs ; 10 % for heat, light, and furnishings ; 15 % for clothing ; and 10 % for health, amusements, and education. Find how much he spent for each item and how much he saved.

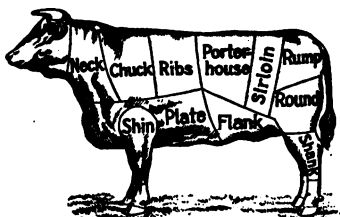
4. A family of five had an income of \$2400. Their expenses were: rent and repairs, \$420; food, \$700; heat, light, and furnishings, \$240; clothing, \$432; health, education, and amusements, \$480. Find, to the nearest tenth per cent, what per cent of the income was spent for each item and what per cent was saved.

5. In the following table find how much was spent for each item and how much was saved by family A ? B ? C ? What per cent of their income was spent for each item and what per cent was saved by family D ? by family E ?

YEARLY INCOME	A	B	C	D	E
	\$840	\$1240	\$1800	\$2600	\$5000
Food	30 %	28 %	25 %	\$780	\$1250
Rent and repairs	18 %	21 %	18 %	520	900
Heat, light, and furnishings	12 %	9 %	10 %	260	500
Clothing	14 %	16 %	15 %	320	700
Health, education, amusements, charity	15 %	18 %	20 %	520	1000
Sundries	5 %	2 %	8 %	100	150
Savings	6 %	6 %	4 %	100	500

Cuts of Beef, Lamb, and Pork

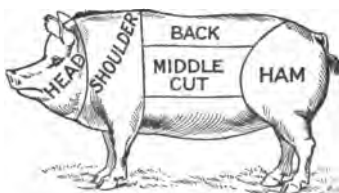
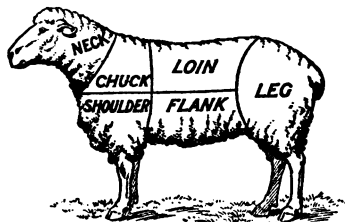
1. Find the total weight of the dressed animal (both sides) if one side contains the number of pounds shown below. Find also the total value.



	POUNDS	
Porterhouse	50	@ \$.55
Sirloin	30	@ .55
Round	84	@ .50
Rump	18	@ .28
Ribs	48	@ .30

	POUNDS	
Shank	13	@ \$.25
Shin	12	@ .25
Neck and chuck	150	@ .25
Flank	24	@ .20
Plate	110	@ .19

2. What per cent of the total dressed weight of the animal is the porterhouse? the sirloin? the round? the rump? the ribs? the shank? the shin? the neck and chuck? the flank? the plate?



3. Find the cost of a forequarter of lamb (neck, chuck, shoulder, flank), 11 lb. @ \$.25, and the cost of a hindquarter (loin and leg), 15 lb. @ \$.48.

4. Find the value of a side of pork as follows:

11 lb. ham @ 45¢

12 lb. back @ 45¢

7 lb. sausages @ 30¢

6 lb. shoulder @ 42¢

10 lb. middle cut @ 43¢

6½ lb. head @ 20¢

Making out Sales Slips

Make out sales slips for the following purchases in this form :

Name			
Address			
CLERK No.	AMOUNT REC'D	AMOUNT OF SALE	DATE
QUANTITY	ARTICLE		AMOUNT
	Total		
	Change due		

1. Edith Mason bought $2\frac{1}{4}$ yd. lace @ 32ϕ ; $2\frac{5}{8}$ yd. edging @ 7ϕ ; $1\frac{1}{4}$ yd. chiffon @ \$2.50. Amount received, \$5.

2. Cora Wise bought $\frac{1}{2}$ doz. linen towels @ \$6.75; $\frac{3}{4}$ doz. linen napkins @ \$5.79; $1\frac{1}{2}$ doz. kitchen towels @ \$2.95. Amount received, \$13.

3. Ruth Wade bought $5\frac{1}{4}$ yd. serge @ \$2.35; $4\frac{7}{8}$ yd. wool Jersey cloth @ \$2.75. Amount received, \$30.

4. Alice Miner bought 1 chiffon blouse @ \$5.95; $5\frac{5}{8}$ yd. ribbon @ 29ϕ ; $2\frac{1}{4}$ yd. braid @ 19ϕ . Amount received, \$10.

5. Clara Holt bought $\frac{1}{2}$ doz. pencils @ \$.35; 1 box writing paper @ \$.59; $\frac{1}{4}$ gross pens @ \$1.50; $\frac{1}{2}$ doz. pads @ \$1.15; 1 fountain pen for \$2.75. Amount received, \$5.

6. Emma Stone bought $\frac{3}{8}$ yd. damask @ \$2.25; $\frac{1}{4}$ doz. napkins @ \$5.90. Amount received, \$3.

7. Maud Smith bought $13\frac{5}{8}$ yd. cretonne @ 45ϕ ; $12\frac{3}{8}$ yd. ribbon @ $12\frac{1}{2}\phi$; $6\frac{5}{8}$ yd. braid @ 19ϕ ; $7\frac{1}{4}$ yd. lace @ 17ϕ ; $2\frac{5}{8}$ yd. edging @ 9ϕ . Amount received, \$15.

PROBLEMS WITHOUT NUMBERS

1. Suppose that you know the rate of taxation in your town. How can you find out how much your father must pay on the assessed valuation of his property?
2. Suppose that you have an invoice of goods imported from abroad and that you know the rate of ad valorem duty. How can you find the amount of duty that must be paid?
3. If your father knows the rate of insurance, how can he tell how much it will cost him to insure his house for a given amount?
4. How can you tell the number of board feet in a plank when you know its thickness, its width, and its length?
5. The Food Administration has issued a receipt for some wheatless muffins. You wish to make a certain number of times the quantity. How should you change the receipt?
6. How can you tell, by means of a scale on a map, how far it is from one city to another?
7. How can you find out the number of rolls of paper needed for the walls of a room of given dimensions?
8. How can you find the number of yards of carpet of a given width needed for a floor of given dimensions?
9. If you know the dimensions of a hall, how can you find the number of square yards of plaster needed to cover the walls, and the ceiling?
10. You know the time in a place in the Central time belt. How can you find the time in the Eastern belt? in the Mountain belt? in the Pacific belt?
11. How can you divide a number into parts having a given ratio to one another?
12. If you know the first three terms of a proportion, how can you find the fourth term?

TESTS FOR ACCURACY AND SPEED

NOTE. In such exercises the pupils may occasionally "run number races" to see how many correct answers each pupil can get in a given time. Establish a class standard and let each pupil drill until he has reached it.

Time yourself with these exercises. Drill on certain sets assigned by your teacher, until you can meet the class standard.

Read the following numbers. Then add and test :

- | | | |
|---------------|-----------------|-----------------|
| 1. 837,032 | 2. \$ 8356.12 | 3. 63.0258 |
| 64,018 | 3918.04 | 54.009 |
| 5,024 | 56.08 | 710.356 |
| 32,086 | 343.56 | 814.607 |
| 921,052 | 7020.08 | 500.0392 |
| <u>81,008</u> | <u>35218.72</u> | <u>694.7836</u> |

- | | | |
|-------------------------------------|------------------------------------|-------------------------------------|
| 4. $839\frac{3}{8}$ | 5. $721\frac{3}{8}$ | 6. $720\frac{5}{16}$ |
| <u>$632\frac{5}{12}$</u> | <u>$365\frac{5}{8}$</u> | <u>$849\frac{8}{10}$</u> |

Subtract and test :

- | | | |
|-------------------------------------|-------------------------------------|------------------------------------|
| 7. 7000.00 | 8. 7654.321 | 9. 54,321.004 |
| <u>1326.78</u> | <u>5989.999</u> | <u>43,456.789</u> |
| 10. $921\frac{3}{4}$ | 11. $583\frac{1}{8}$ | 12. $836\frac{7}{16}$ |
| <u>$329\frac{3}{10}$</u> | <u>$429\frac{5}{12}$</u> | <u>$638\frac{5}{8}$</u> |

Find the products :

- | | | |
|---------------------------------------|--|--|
| 13. 75.054 | 14. 635.098 | 15. 333.0025 |
| <u>.0059</u> | <u>21.029</u> | <u>7.56</u> |
| 16. $\frac{7}{8} \times \frac{5}{12}$ | 18. $\frac{4}{25} \times \frac{3}{16}$ | 20. $2\frac{3}{8} \times 3\frac{1}{2}$ |
| 17. $\frac{3}{4} \times \frac{5}{16}$ | 19. $\frac{4}{5} \times \frac{9}{10}$ | 21. $3\frac{3}{8} \times 5\frac{1}{2}$ |

Find the quotients :

- | | | |
|------------------------------------|------------------------------------|--|
| 22. 1275 ÷ 55 | 24. 11,841,616 ÷ 342 | |
| 23. 3136 ÷ 98 | 25. 26.9646 ÷ 3.457 | |
| 26. $\frac{4}{5} \div \frac{3}{8}$ | 27. $\frac{7}{8} \div \frac{3}{4}$ | 28. $12\frac{5}{16} \div 3\frac{3}{4}$ |

Find:

- | | |
|------------------------------|---------------------------------------|
| 29. $33\frac{1}{3}\%$ of 360 | 32. 1.25% of 568 mi. |
| 30. 20% of 840 | 33. $87\frac{1}{2}\%$ of 3424 cu. in. |
| 31. 150% of 200 gal. | 34. $87\frac{1}{2}\%$ of 5680 A. |

Find what per cent the first number is of the second:

- | | |
|--------------|-----------------------|
| 35. 25 of 75 | 37. \$28 of \$224 |
| 36. 18 of 72 | 38. 30 mi. of 160 mi. |

Find the profit or loss:

- | | COST | RATE OF GAIN | | COST | RATE OF LOSS |
|-----|-------|-------------------|-----|---------|--------------|
| 39. | \$200 | 30% | 41. | \$25.50 | 10% |
| 40. | \$800 | $12\frac{1}{2}\%$ | 42. | \$83.75 | 20% |

Find the per cent of profit or loss:

- | | COST | SELLING PRICE | | COST | SELLING PRICE |
|-----|-------|---------------|-----|---------|---------------|
| 43. | \$500 | \$600 | 45. | \$20.50 | \$10.25 |
| 44. | \$300 | \$500 | 46. | \$18.75 | \$12.50 |

Find the discount and the net price:

- | | LIST PRICE | RATE OF DISCOUNT | | LIST PRICE | RATES OF DISCOUNT |
|-----|------------|------------------|-----|------------|-------------------|
| 47. | \$400 | 10% | 49. | \$700 | 10%, 5% |
| 48. | \$600 | 5% | 50. | \$400 | 25%, 1% |

Find the commission:

- | | SALES | RATE OF COM. | | SALES | RATE OF COM. |
|-----|-------|--------------|-----|--------|-------------------|
| 51. | \$600 | 10% | 53. | \$6400 | $37\frac{1}{2}\%$ |
| 52. | \$750 | 15% | 54. | \$1600 | $16\frac{2}{3}\%$ |

Find the amount of taxes on the following property:

- | | ASSESSMENT | TAX RATE | | ASSESSMENT | TAX RATE |
|-----|------------|-----------|-----|------------|----------------------|
| 55. | \$5000 | \$0.23 | 58. | \$25,000 | 3.3 mills |
| 56. | \$10,000 | \$0.34 | 59. | \$17,500 | $5\frac{1}{2}$ mills |
| 57. | \$15,000 | 2.5 mills | 60. | \$18,000 | $3\frac{1}{4}$ mills |

Find the tax rate:

	ASSESSED VAL.	TOTAL TAX		ASSESSED VAL.	TOTAL TAX
61.	\$9,000,000	\$1800	63.	\$6,500,000	\$26,000
62.	\$1,000,000	\$2250	64.	\$15,000,000	\$90,000

Find the duty:

	VALUE	AD VAL. DUTY		QUANTITY	SPECIFIC DUTY
65.	\$2400	25 %	67.	500 lb.	\$1.25 a pound
66.	\$3000	30 %	68.	250 bu.	.05 a bushel

Find the interest and the amount:

	PRIN.	RATE	TIME		PRIN.	RATE	TIME
69.	\$450	6 %	1½ yr.	71.	\$1000	5 %	1 yr. 1 mo.
70.	\$320	5 %	2¼ yr.	72.	\$2200	6 %	1 yr. 6 mo.

Find the annual premium:

	FACE (Fire Insur.)	RATE		FACE (Life Insur.)	RATE
73.	\$4500	\$45 per \$100	75.	\$5000	\$23.40 per \$1000
74.	\$5600	\$75 per \$100	76.	\$10,000	\$35.60 per \$1000

Find the cost at \$50 per M of:

77.	10 boards 1" × 12" - 15'	79.	40 sills 8" × 10" - 25'
78.	25 boards 2" × 6" - 16'	80.	10 planks 3" × 12" - 15'

Find the cost, at \$.35 a roll, of papering the walls of:

- 81. Parlor 15 ft. × 24 ft. × 8 ft.
- 82. Library 16 ft. × 18 ft. × 8 ft.
- 83. Bedroom 15 ft. × 18 ft. × 7 ft.
- 84. Bathroom 8 ft. × 9 ft. × 7½ ft.

How many yards of plain carpet 1 yd. wide (laid in the most economical way) are needed for a floor:

- 85. 15 ft. × 20 ft.
- 86. 16 ft. × 18 ft.
- 87. 14 ft. × 17 ft.
- 88. 10 ft. × 12 ft.
- 89. 15 : 45 = ?
- 90. 2 : 4 = 4 : ?
- 91. 5 : 20 = ? : 40
- 92. 80 : 25 = ?
- 93. ? : 15 = 10 : 30
- 94. 3 : ? = 6 : 30

CHAPTER III

BUSINESS WITH BANKS

It is much better to form the habit of saving money than of borrowing it; but sometimes borrowing is necessary. If a boy feels that he needs a college education which his parents cannot afford to pay for, he is wise to borrow the money rather than to miss the education.



In the same way a manufacturer or a business man often finds it advantageous to borrow money, which he can readily repay when his goods are sold.

An institution that receives, lends, or exchanges money is called a **bank**.

Name several banks in your community. How many different kinds have you? In what kinds of banks can you deposit money and draw checks on your deposit?

Among the various forms of banks in the United States may be mentioned **federal reserve banks** and **national banks**, which are under control of the federal government; **state banks**, which are under the control of the state; **private banks**; and **savings banks**.

A **trust company** is an institution empowered by its charter to accept and execute all kinds of trusts, to act as executor, administrator, assignee, and receiver. In most states it is empowered also to do a general banking business.

The chief business of banks is to receive deposits for safe keeping; to lend money on approved security; and to collect drafts and bills of exchange.

Federal reserve banks are central banks in the national banking system. They were organized to extend our currency system and to lend money to other banks when needed. They also issue notes, called bank notes, that circulate as money.

How to open an account with a bank.

When a person opens an account with a bank, he first fills out a deposit slip, as here shown, and gives it, together with the deposit, to the cashier or receiving teller.

DEPOSITED WITH		
First National Bank		
ELKHART, INDIANA		
By <u>James Anderson</u>		
<u>Oct. 10,</u> 19 <u>19</u>		
	Dollars	Cents
<i>Bills</i>	50	
<i>Gold</i>	60	
<i>Silver</i>	20	
<i>Checks</i>		
ENTER CHECKS SEPARATELY		
<i>1st Nat. Bank</i>	65	80
<i>Union Trust Co.</i>	130	10
<i>Total</i>	325	90

Some banks require the name of the bank on which the check is issued to be written on the deposit slip.

The depositor writes his name and address in a book or on a card kept by the bank, so that the bank may have his signature for identification.

He then receives a bank book, which is usually presented to the teller when a deposit is made, in order that the dates and the amounts of all the deposits may be entered.

The depositor also receives a check book, each page of which has one or more blank checks and stubs.

Get deposit slips from friends or from a bank and fill them out with records of various deposits.

CHECKS

STUB

CHECK

\$900 ²⁵		No. 14	No. 14 Salem, Oregon, June 26, 1919
June 26, 1919		Federal Trust Company	
To John R. Lane			
For Rent		Pay to the	
Bal. For'd	2 000 50	order of John R. Lane ----- \$900 ²⁵	
Amt. this check	900 25	Nine hundred and $\frac{25}{100}$ ----- Dollars	
Bal. for'd	1 100 25	Robert Smith	

A written order by a depositor, directing the payment of money by a bank is called a **check**.

The **stubs** remaining in a check book after the checks are torn out give a record of the checks issued.

Robert Smith is called the **maker** of the above check and John R. Lane the **payee**.

John R. Lane **indorses** this check by writing his name on the back. This is an **indorsement in blank**. The check is then payable to anybody else who receives it and adds his indorsement.

An **indorsement in full** would read: "Pay to the order of James Blank, John R. Lane." With this indorsement, nobody but James Blank can collect or indorse the check.

Checks made out *to bearer*, to *cash*, to *John Blank or bearer* may be collected by the bearer. Checks made out to "Myself" may be collected only by the maker.

1. Make out and indorse several checks.
2. Suppose Mr. George Boyd, Toledo, Ohio, wishes to send a check for \$500 to Mr. Henry Allen of Hartford, Conn., in payment of an account. First, write the checks as indorsed by Mr. Boyd in blank; second, as indorsed in full.
3. Why is it better to indorse a check in full, especially if it is to be sent by mail?

NOTE. A check issued in payment of a bill serves as a receipt. Sometimes the maker adds above his signature a statement like this: "In full for payment of bill of April 1, 1919."

Balancing Accounts, Depositing, and Checking on Accounts.

4. Your deposits in a bank for the month of September are as follows: Make out deposit slips and find the balance Oct. 1, if the balance on Sept. 1 was \$560.55.

Sept. 1, bills, \$50; silver, \$10; check, \$15.

Sept. 6, bills, \$20; silver, \$10; check, \$100; gold, \$20.

Sept. 10, bills, \$45; silver, \$4.75.

Sept. 16, bills, \$20; silver, \$3.40; check, \$80.

Sept. 25, gold, \$40; check, \$40; silver, \$10.

Sept. 29, check, \$80; bills, \$80; silver, \$35.

5. Your check book shows the following: Write the checks for bills paid in November, and find the balance in bank.

Balance in bank Nov. 1, \$847.10.

No. 1, Nov. 4, Keller Bros., for coal, \$15.50.

No. 2, Nov. 4, the George K. Stevenson Company, for groceries for October, \$49.50.

No. 3, Nov. 4, Dr. S. N. Pool, for services to date, \$90.

No. 4, Nov. 5, cash, \$55.

No. 5, Nov. 7, John Horne, for merchandise, \$65.30.

No. 6, Nov. 11, Midland Company, for lumber, \$93.75.

No. 7, Nov. 15, the Johnson Company, for repairs on automobile, \$29.35.

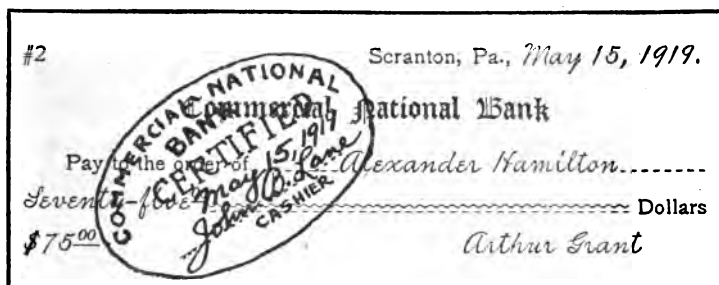
No. 8, Nov. 19, cash, \$25.

No. 9, Nov. 24, James McFarland, for interest due, \$24.

No. 10, Nov. 27, Philip H. Waite, for merchandise, \$15.63.

No. 11, Nov. 29, Myself, \$25.

A **certified check** is a notice to the payee of the check that the amount named on the face has been taken from the maker's deposit and placed with the bank's funds for the payment of the check when presented.



CERTIFIED CHECK

Certified checks are frequently demanded in payment of notes and collections of banks, and in payments where the payee does not wish to take a personal check. Like other checks, they are mailed daily in payment of bills in all parts of the country.

6. Write a certified check for \$800 in payment of a lot bought of James Gray.

7. The Moore Company, Madison, Wis., purchased \$825 worth of furniture at 20 % and 10 % off from James Boyd, Detroit, Mich., 3 % off for cash in 10 days. They sent a certified check within ten days on the Lincoln Trust Company, of which William Pratt is secretary and treasurer. Write the certified check.

NOTE. The *secretary and treasurer* of a trust company corresponds to the cashier of a bank.

8. John Clay of Chicago, Ill., receives a certified check on the People's Bank of Cheyenne, Wyo., from Freeman Lewis for \$730.80. Write this check.

Banks often charge a fee of 10 cents or more for cashing checks on out-of-town banks.

PROMISSORY NOTES

John White owes Paul Ames \$1000 for merchandise ; but instead of paying him at once he asks Mr. Ames to accept his note promising to pay the bill in three months.

\$1000 ⁰⁰	Salem, Oregon, Nov. 21, 1919
Three months after date...I...promise to pay to the	
order of.....Paul Ames.....	
One thousand ⁰⁰	Dollars
Value received, with interest at 6 %	
Due Feb. 21, 1920	John White

A written promise to pay to a certain person or to his order, a specified sum of money on demand or at a specified time is called a *note* or a *promissory note*.

The Essentials of a Promissory Note

1. It should be *signed* by the maker.
2. It should state the *place* where and the *time* when given.
3. It should promise to pay to a *certain person* or to his *order*.
4. It should promise to pay a *certain sum of money*, expressed both in *figures* and in *writing*.
5. It should state *when* the money is to be paid.
6. It should state *by whom* the money is to be paid.
7. It should state *with interest* and the rate, if it bears interest.

Although the words *for value received* are not essential, they are usually written in a note.

Write two promissory notes, observing the essentials.

The person who signs a note is called the **maker** of a note.

When a note is payable to the order of a person, he alone can collect it, or sell it by indorsement. When it is payable to a person, or bearer, the holder can collect it, or sell it by indorsement.

The person named in the note (to whom it is payable) is called the **payee** of the note.

The sum written in the note is called the **face** of the note.

In the note on p. 164, John White is the *maker*, Paul Ames, the *payee*, and one thousand dollars is the *face*.

As this note reads "pay to the *order of* Paul Ames," Mr. Ames has the right to sell the note by writing his name across the back and delivering it to the purchaser.

When the owner of a promissory note writes his name across the back of it, he is said to **indorse** the note.

Promissory notes may be **indorsed** as follows:

(1) **In blank:** In this form the indorser simply writes his name across the back of the note, thus making the note payable to the holder.

INDORSEMENT IN BLANK

Paul Ames

(2) **In full:** In this form the indorser designates that the note is to be paid to the order of a definite person. It must be indorsed by this person before it can be collected.

INDORSEMENT IN FULL

*Pay to the order of
John Burke
Paul Ames*

Banks must notify indorsers in a prescribed manner in case a note is not paid when due. This is called **protesting** the note. If the note is not protested, the indorsers are released from the liability of payment.

Interest: If either a time or a demand note contains the words *with interest*, the note bears interest from date at the legal rate in the state where it is issued, unless a definite rate is mentioned in the note.

Forms of Notes. — The note on p. 164 is a **time note**. If *on demand* is substituted for *three months after date*, it will be a **demand note**. A promise made by one person is an indi-

vidual note ; a promise signed by more than one person, and containing the words *we or either of us* is called a **joint and several note**.

A note is said to **mature** on the last day of the time named in the note. Some states allow three additional days, called "days of grace." Days of grace are now abolished in most states. The note on p. 164 matures Feb. 21, 1920.

If a note falls due on **Saturday, Sunday, or a legal holiday**, it is usually payable on the next *succeeding* business day. Some states require such notes to be paid on the *preceding* business day.

Oral and Written Work

1. Is the promissory note given by Mr. White (p. 164) an individual or a joint and several note?

2. Write a promissory note, in which you are the maker for \$125 due in 6 months, payable to the order of James Worth, with the legal rate of interest in your state.

3. Mr. Worth sells this note to George Clay, and indorses it in full. Write the indorsement on the note.

4. Write a joint and several note for \$250, dated Sept. 24, 1919, due on demand, with interest at 6 %, payable to the order of Willard Howe. Your friend may sign this note as one of the makers.

5. If a payee wishes to sell a note without responsibility for its payment in case the maker fails to pay it, he should indorse it "without recourse," followed by his name. Write such an indorsement for the note in Ex. 4.

6. Find the amount paid to the holder of Mr. Howe's note (Ex. 4), if settled Jan. 4, 1920.

Time, Sept. 24, 1919 to Jan. 4, 1920 = 102 days. (See table, p. 317.)

7. Name the different kinds of negotiable notes : (1) as to *time*; (2) as to the *number of makers*.

\$ 300 ⁰⁰	Dayton, Ohio, March 1, 1919
<i>Ninety days after date...I...promise to pay to the</i> <i>order of</i> <i>Alfred Bryce</i> <i>Three hundred</i> ⁰⁰ <i>Dollars</i> <i>Value received</i>	
James Orr	

NOTE. When a note is payable a number of days after date, the exact days are usually counted (March, 30 da.; April, 30 da.; May, 30 da.). Therefore this note matures May 30, 1919. If it were payable "three months after date," it would mature June 1, 1919.

Consider 30 da. as $\frac{30}{360}$ yr., or $\frac{1}{12}$ yr.; 60 da. as $\frac{1}{6}$ yr.; 90 da. as $\frac{1}{4}$ yr.

If the words *with interest* are omitted from a time note, it bears interest from the date on which it is due.

8. Find the amount due at maturity on a 90-day note for \$3000, with interest at 6%.

SOLUTION. Interest on \$3000 for 90 da. at 6% = \$45; \$3000 + \$45 = \$3045, amount due.

9. Find the interest at 5% due on a demand note for \$1000, dated Jan. 22, 1919, and settled July 21, 1919.

Find the amount due at date of settlement on the following notes. On overdue, non-interest bearing notes, compute interest at 6%.

	DATE	FACE	TIME	PAYEE	MAKER	INT. RATE	SETTLEMENT
10.	2/ 5/19	\$100	6 months	George Kimes	Yourself	6 %	Maturity
11.	4/21/19	250	On demand	A. J. Edwards	James Clyde	8 %	7/20/19
12.	6/10/19	500	1 year	John Dunn	John Grant		6/10/21
13.	8/16/19	350	6 months	N. J. Noel	James Palm		12/16/21
14.	7/12/19	125	On demand	James Bryce	Yourself	7 %	1/ 8/20

SOLUTION TO EX. 10. Time = 6 mo. Int. for 6 mo. on \$100 = \$3.
Amount = \$103.

BANK DISCOUNT

Turn to the note on p. 167. If Mr. Bryce needs money at once, he may indorse this note and take it to his bank. If his credit is satisfactory, the bank will **discount** the note, that is, the bank will purchase the note and credit the account of Mr. Bryce with the face of the note, less the interest at the current rate for the time the note runs. This interest, collected by the bank *in advance*, is called **bank discount**.

The money received by the borrower, which is the face minus the interest, is called the **proceeds**.

At 6 % the *bank discount* on \$300 for 90 days = \$4.50. The *proceeds* = \$300 - \$4.50, or \$295.50.

When the note is due, its face value, \$300, will be collected by the bank from James Orr, or if he fails to pay, from Alfred Bryce.

Often a business man wishes to borrow money on his own note. Such a note may take the following form:

\$ 2000 ⁰⁰	Richmond, Va., Sept. 8, 1919
<i>Three months after date . . . I . . . promise to pay to</i> <i>the order of Myself at the</i> <div style="text-align: center; font-weight: bold; margin: 10px 0;">First National Bank</div> <i>Two thousand⁰⁰ Dollars</i> <i>Value received</i>	
	Walter Post

If Mr. Post has a satisfactory account with his bank, he will indorse the note, and the bank will credit the *proceeds* (\$2000 - \$30, or \$1970, if the rate is 6 %) to his account. On Dec. 8, 1919, the date of maturity, the bank will charge Mr. Post's account with the \$2000. The bank will return the note when the account is balanced.

Such a note is known as **single-name paper**.

Often the bank demands another indorsement — **two-name paper**.

Sometimes banks require, in addition to the note, a deposit of certain securities, such as stocks, bonds, or mortgages, as a pledge that the loan will be repaid. Such notes, called **collateral notes**, contain a list of the securities deposited.

The number of days from the date of discount to the date of maturity is called the **term of discount**.

There are two methods, however, of reckoning this term. The first method counts the day of maturity but not the day of discount ; the second counts both.

Thus, by the first method in the note on p. 168 Mr. Post had the use of the money 22 days in Sept., 31 days in Oct., 30 days in Nov., and 8 days in Dec., or 91 days in all. (See also Table, p. 317.) By the second method he had the use of the money 23 days in Sept., 31 days in Oct., 30 days in Nov., and 8 days in Dec., or 92 days in all.

NOTE. Answers in this book are given by the first method.

When days of grace are allowed they are included in the term of discount, but in this book days of grace are not reckoned.

1. How much does the bank pay to Mr. Post? How much does Mr. Post pay to the bank at maturity?

2. If Mr. Post had borrowed \$2000 from Mr. Brown for 3 months with interest at 6%, how much would he have paid Mr. Brown when the note became due?

While *banks* require the interest on *time notes* to be paid in advance, *individuals* demand interest when the note is due, or annually on long-time notes. In *demand notes* the interest is usually payable quarterly, at the legal rate, unless a different rate is specified in the note.

3. If Mr. Post had taken out a *demand note* for \$2000 at the bank, with interest at 6%, how much interest would he have paid at the end of 3 months?

Written Work

Find the date of maturity of the following:

DATE	TIME	DATE	TIME
1. June 1	60 days	4. Jan. 2	3 months
2. July 3	2 months	5. March 3	30 days
3. Aug. 5	90 days	6. April 1	90 days

SOLUTION TO Ex. 1. 29 da. (June) + 31 da. (July) = 60 da.

Ans. July 31.

Find the date of maturity and the term of discount:

DATE OF NOTE	TIME OF NOTE	DATE OF DISCOUNT	DATE OF NOTE	TIME OF NOTE	DATE OF DISCOUNT
7. March 1	60 da.	April 1	10. June 3	90 da.	Aug. 2
8. April 10	3 mo.	June 15	11. March 23	4 mo.	June 2
9. July 10	4 mo.	Sept. 30	12. June 5	90 da.	July 10

SOLUTION TO Ex. 7. Maturity date, April 30; term of discount, April 1 to April 30, 29 da.

How to find the bank discount and the proceeds.

1. Find the bank discount and the proceeds of a 90-day note for \$1000 dated March 1, 1919, and discounted at 6% April 1, 1919.

SOLUTION. Date of maturity, May 30; term of discount, April 1 to May 30, 59 da.

Interest on \$1000 for 59 da. at 6% = \$9.84, *bank discount*; \$1000 - \$9.84 = \$990.16, *proceeds*.

Find the date of maturity, the bank discount, and the proceeds, if the following notes are discounted on the date when made.

DATE OF NOTE	TIME	FACE	RATE OF DISCOUNT
2. Aug. 10, 1919	90 da.	\$ 100	6 %
3. June 12, 1920	2 mo.	500	6 %
4. July 2, 1919	3 mo.	1000	5 %
5. Jan. 8, 1920	4 mo.	625	6 %
6. Mar. 5, 1920	60 da.	2000	4½ %
7. May 8, 1920	60 da.	1500	6 %

DATE OF NOTE	TIME	FACE OF NOTE	RATE OF DISCOUNT
8. Sept. 1, 1920	1 mo.	\$1200	5 %
9. Dec. 1, 1920	30 da.	2500	6 %
10. Mar. 5, 1920	90 da.	5000	5½ %

11. Mr. Charlton sells a horse for \$174 and takes a promissory note from the buyer, Henry Austin, for ninety days without interest. Thirty days after the date of the note, Mr. Charlton discounts it at his local bank at 5 %. Find the proceeds.

12. The Stone Company take a note August 1, 1919, from Thomas Rowal for \$150 due in six months. Needing money, they get this note discounted at their local bank December 10, 1919, at 6 % discount. Write the note. Then write the indorsement. Find the proceeds.

13. Mr. Holt is in business and takes a time note, without interest, for \$125 from Richard Foote, April 1, 1919, for one year. He discounts this note January 10, 1920, at his local bank at 6 % interest. Write this note. Then indorse it and present it to your teacher (as banker) for discount. Find the proceeds.

14. Mr. Davis takes Robert Burke's note on demand for \$200 May 1, 1919, at 6 %. September 1, Mr. Davis makes demand for the money. How much will it take to pay the note?

PARTIAL PAYMENTS OF PROMISSORY NOTES

It is frequently inconvenient for the borrower to pay the face of the note all at one time. He is sometimes permitted, by special contract, to make payments at any time or at interest-bearing periods, until the note is paid. These amounts are called **partial payments** and are credited on the back of the note, together with the date of payment.

MERCHANTS' RULE

In some localities the following rule is used on notes running a year or less.

Find the amount of the principal from the time it begins to bear interest to the date of settlement.

Find the amount of each payment from the time it was made to the date of settlement.

From the amount of the principal, subtract the sum of the amounts of the payments. The result will be the balance due.

Written Work

1. Find the amount due Oct. 1, 1919, on a note for \$1000 dated Feb. 1, 1919, with interest at 6%. Indorsement, July 1, 1919, \$500.

SOLUTION

Principal									\$1000
Interest on \$1000 Feb. 1 to Oct. 1 (8 mo.)	.	.	.	.	.	.	.	.	40
Amount of \$1000 Oct. 1									<u>\$1040</u>
Interest on \$500 July 1 to Oct. 1 (3 mo.)	\$7.50								
Amount of \$500 Oct. 1, 1919									507.50
Balance due Oct. 1, 1919									<u>\$532.50</u>

2. Find the amount due Nov. 1, 1919, on a note for \$1500 dated May 1, 1919, with interest at 6%. Indorsement, Aug. 1, 1919, \$1000.

UNITED STATES RULE

Find the amount of the principal to the time of the first payment, and from the amount subtract the first payment. Consider the remainder as a new principal and proceed as before until the time of final settlement. If any payment does not equal or exceed the interest, then find the interest to the time when two or more payments equal or exceed the interest.

This is the United States rule of partial payments, and is the legal one in most states.

The Supreme Court of the United States has decreed:

(1) That the payment on a note must first be applied to cancel the interest then due, before the principal may be diminished.

(2) That interest must not be charged upon interest.

Written Work

1. A borrower gives the following note:

\$ 1000 ⁰⁰	Portland, Oregon, Nov. 1, 1917
On demand, for value received, I promise to pay	
James Jones	or order,
One thousand ⁰⁰	Dollars
With interest at 6 %	Henry Brown

The following payments are indorsed on this note:

Nov. 1, 1918, \$160
May 1, 1919, \$25

What amount is due Nov. 1, 1919?

SOLUTION

Principal	\$1000.00
Interest on \$1000, Nov. 1, 1917, to Nov. 1, 1918 (1 yr.)	60.00
Amount of \$1000, Nov. 1, 1918	\$1060.00
Payment Nov. 1, 1918	160.00
Balance = new principal due Nov. 1, 1918	\$900.00
Interest on \$900, Nov. 1, 1918, to May 1, 1919 (6 mo.), \$27.	
As the interest exceeds the payment of \$25 made May 1, 1919, a new principal is not formed.	
Amount of \$900, Nov. 1, 1918, to Nov. 1, 1919 (1 yr.)	\$954.00
Less payment \$25, May 1, 1919	25.00
Amount due Nov. 1, 1919	\$929.00

2. On a claim of \$850, dated May 2, 1917, interest 5 %, the following payments were made: May 2, 1918, \$200; May 2, 1919, \$200. How much was due May 2, 1920?

3. A note of \$1000, dated Aug. 5, 1918, bearing interest at 6 %, had the following payments indorsed upon it: Feb. 5, 1919, \$200; Aug. 5, 1919, \$30. Find the amount due Aug. 5, 1920.

INVESTING MONEY

It is quite as important to know how to invest money wisely as how to save it. When people keep much money about the house they not only lose the interest, but they run the risk of being robbed. When they are induced by an offer of a large interest to invest with dishonest men or in unsafe enterprises, they run the risk of losing their savings.

In many eastern states 5 % to 6 % interest and in western states 6 % to 8 %, on good security, is considered safe.

Safe investments. — The **United States government** pays 2 % interest on postal savings deposits and $2\frac{1}{2}$ % to $4\frac{1}{4}$ % on U. S. Government bonds.

Cities and towns pay from $3\frac{1}{2}$ % to 5 % on city or village bonds.

Savings banks pay 3 % to 4 % interest on the money deposited.

Men who borrow money on **notes** or take **mortgages on real estate** usually pay from 5 % to 8 % interest.

The safety of an investment in real estate depends on its cash valuation, the yearly returns from the property, and the probable increase in valuation.

Real estate is often purchased by paying part of the price in cash and giving a mortgage for the remainder. A **mortgage** is a legal paper similar to a promissory note, but giving the lender, as security, a claim on the property until the loan, with interest, has been paid.

The safety of a loan on real estate is to be determined by considering whether the property will sell for the amount lent in case the owner of the property fails to pay the loan when due. Care must be taken to see that all taxes are paid, and that the property is insured.

Written Work

1. Compare the relative incomes in two years from the investment of \$1000 in a United States $4\frac{1}{2}\%$ Liberty bond; in a savings bank paying 4% interest; in a mortgage on George Steele's house, at 5% interest; and in a loan to Miles Anderson, with security, at 6%.

2. Mr. Root buys a house for \$10,000, paying \$5000 cash and giving a mortgage on the property for the rest. Find the semiannual interest due on this mortgage at 6%.

3. Mr. Arnold purchases a house for \$3000, which he rents at \$30 a month. The yearly taxes are \$45, repairs are \$50, and insurance is \$5. What is his net income from the investment?

4. After two years Mr. Arnold sells the house for \$4200. What has been the average yearly income?

SOLUTION. $\$4200 - \$3000 = \$1200$; $\$1200 \div 2 = \600 ; $\$600 + \$260 = \$860$.

5. Mr. Cole buys a house for \$5000, which he rents for \$25 a month. The taxes and insurance average \$105; repairs and loss of rent \$50. Find the yearly per cent of income on the investment.

6. Mr. Cole sells the property in 4 years for \$8000. Find the average yearly per cent of profit on the investment.

7. Mr. Reed buys a vacant lot for \$300. The taxes average \$7 a year. He keeps the lot 4 years and then sells it for \$325. Find the per cent of loss for the time, if the \$300 was previously invested at 5% interest.

8. Mr. Burt buys a house for \$3000 on which there is a mortgage of \$1500, with interest at 6%. The taxes, insurance, and repairs average \$80 a year. For how much must he rent the house to realize 6% on the investment?

9. In estimating returns on houses, an allowance must always be made for loss of rent when the house is vacant, or when the rent is uncollectible. Allowing \$50 a year for loss of rent and cost of collections, find the per cent of return on a house valued at \$3000 that rents for \$25 a month.

10. Charles Painter buys a house and lot for \$4000 and keeps it for one year. He spends \$54.75 for advertising, \$20 for insurance, \$15 for taxes, and 2% for selling the house at \$4250. Does he gain or lose, and how much, if money is worth 5% interest?

11. Mr. Ford decides to purchase a house and lot for \$3000. The rent is \$30 a month, and taxes, repairs, and other expenses are \$100 a year. After four years, he sells the property for \$4500. Counting interest only on the purchase price, how much better is this than a straight loan for four years at 6% interest?

12. Mr. Grant lends \$1000 at 6% interest for 3 yr. on a lot secured by a mortgage. How much is due Mr. Grant, with interest, at the end of 3 yr.?

13. Mr. Gray buys a one-half interest in a store for \$2000, April 1, 1918; April 1, 1920, he and his partner find that the money invested by both, namely \$4000, has yielded $26\frac{1}{2}\%$ profit. Find Mr. Gray's average profit per year.

14. Mr. Buck buys a vacant lot for \$2000. The taxes are \$22 a year. Money being worth 6% interest, what is his profit or loss if he sells the lot after 3 yr. for \$2500?

15. Each of three brothers receives an inheritance of \$2000, July 1, 1919.

(a) George puts his money in a savings bank that day at 4% interest compounded Jan. 1 and July 1.

(b) Henry lends his money at 6% interest with good security for three years.

(c) James buys a house and lot that rents for \$15 a month. He pays \$20 for examining the title and putting the deed on record; the amount of taxes, insurance, repairs, etc., for the three years is \$200. James sells the property at the end of the three years at \$3250.

Find the returns from each investment at the end of the three years.

16. Mr. Mills buys a lot for \$600, May 1, 1919, paying \$500 cash, and giving a mortgage for \$100, payable in one year. May 1, 1920, he sells the lot for \$720 cash. Taxes amount to \$15 and other items to \$15. With interest at 5% on the cash payment and on the mortgage, what rate per cent does his investment yield him?

17. Mrs. Gordon buys a house and lot for \$3000, April 1, 1919. It rents for \$25 a month. The collector charges 5% for collecting the rent. The insurance, taxes, and repairs for the year are \$100. What per cent is realized on the investment?

18. Mr. Gaunt buys a house and lot for \$3500, April 1, 1919. Insurance, taxes, and repairs amount to \$125 a year. For how much per month does he rent the house, if he realizes 6% net on his investment per year?

19. Mr. Gaunt sells this property for \$4250 after renting it for two years, as in Ex. 18, and paying an extra paving bill of \$185. How much profit does he make after deducting 6% interest on the cost of the property?

20. Mr. See has \$2500 to invest. Which will yield the larger income for 3 years and how much,—a house which rents for \$200 a year with expenses of \$284.60 for the 3 years or a mortgage at 6% for 3 years?

21. Mr. Burns buys a vacant lot for \$1500, paying \$500 down and the balance on a mortgage due in 3 years at 6% interest. The taxes average \$15 a year and a paving bill amounts to \$128. Find the cost of the lot to Mr. Burns at the end of the 3 years, including mortgage, interest on mortgage, paving, and taxes.

22. Mr. Alden buys a house and lot in a residence section of the city for \$3500. The taxes and insurance average \$49.50, and repairs \$50 annually. What is the per cent of profit on the investment, if the house rents for \$30 a month?

23. Mr. Alden sells this house for \$3600 after owning it for 3 years. Find the average per cent of profit for each year.

24. Mr. Sands buys a house and lot for \$4000 in the business section of a city. The yearly taxes average \$50, the annual premium for insurance is \$10, and the repairs amount to \$20 a year. A street improvement costs \$200. After renting the house for two years at \$40 a month, he sells the property for \$5600. Find his profit, counting interest at 5% only on the purchase price.

25. Mr. Crane buys a lot for \$400. The taxes average \$6 a year, and a street improvement costs \$80. Three years after buying the lot, he sells it for \$546. Counting interest at 6% only on the cost of the property, find his per cent of loss.

26. Mr. Owen buys a house and lot for \$5000. It rents for \$40 a month. The yearly taxes average \$60, the annual premium for insurance is \$10, and the repairs amount to \$15 a year. A paving bill amounts to \$175. After five years, he sells out for \$10,000. What per cent of gain on the investment of \$5000 does he realize from the sale?



PAYING AND COLLECTING MONEY

Among uncivilized peoples who have not learned the use of money, articles are directly exchanged one for another. The Indian trades his furs for powder, trinkets, blankets, or other articles. In communities on the frontier, the same practice prevails, the settler trading his products with his neighbor for what he needs. In gold-mining countries, the miner often pays for what he buys with gold dust.

As trade increases in amount and variety, better methods of barter must be devised. Pieces of metal, generally of gold or silver, are given or received in more advanced communities, in exchange for articles of use or value. These pieces of metal, stamped by the government and made in convenient shapes and sizes, are called **money**.

For further convenience, governments issue **bills**, which are commonly called **paper money**. These, being so much lighter and less bulky than metallic money, greatly facilitate the transaction of business on a large scale. These bills promise to pay the face value of the bills in gold or silver at any time. They are accepted as money because the governments that issue them are able to keep their promises.

Even these methods of exchange, however, are entirely insufficient for the world's enormous trade, the more so as localities far remote from one another are engaged in trade. Other methods of paying debts, without the transfer of large sums of money from place to place, have therefore been devised. The various methods of **exchange** make it possible to transact business on a large scale, with little trouble, between places widely separated.

BANK DRAFTS

Any method of paying or collecting bills at a distance, without the actual transfer of money is called **exchange**.

Bills may be paid at a distance (1) by **checks** (see p. 161); (2) by **bank drafts**; (3) by **postal money orders**; (4) by **express money orders**; (5) by **telegraphic money orders**.

BANK DRAFTS

A check drawn by one bank on its deposit in some other bank is called a **bank draft**.

Nearly all banks keep deposits in other banks in large commercial centers. By issuing drafts on these banks they avoid the actual transmission of money. Sometimes a small charge known as **exchange** is charged for such drafts.

First National Bank	
<i>Dover, Del., June 2, 1919, No. 1040</i>	
<i>Pay to the order of Ball and Company.....\$ 2500⁰⁰</i>	
<i>Twenty-five Hundred⁰⁰-----Dollars</i>	
<i>To The Mercantile Bank,</i>	
<i>New York, N. Y.</i>	
<i>A. M. Holmer</i>	
<i>Cashier</i>	


BANK DRAFT

Ball and Company of Dover, Del., owe The Wilson Company of New York \$2500. They purchase the above draft at their bank in Dover and indorse it "Pay to the order of The Wilson Company." They then mail it to the Wilson Company who collect payment on it at the Mercantile Bank. The First National Bank of Dover is the drawer of this draft, Ball and Company the payee, and the Mercantile Bank, the drawee.

1. Find the cost of this draft at $\frac{1}{10}$ % exchange.
2. Write a bank draft for \$2600 on the First National Bank of Chicago.

POSTAL AND EXPRESS MONEY ORDERS

If you wish to order from H. K. Brooks, Chicago, \$46.25 worth of merchandise, unless you have credit with him, you may send him either (1) a postal money order, or (2) an express money order. The first will direct the postmaster at Chicago, the second some express agent at Chicago, to pay to the order of H. K. Brooks \$46.25.

WHEN COUNTERSIGNED BY AGENT AT POINT OF ISSUE		EXPRESS MONEY ORDER		10-
				
PAY TO THE ORDER OF		H. K. Brooks \$46.25		
THE SUM OF		Forty six and 25/100 46.25 DOLLARS		
ISSUED AT		New York DATE OF Jan. 17, 1919.		
SIGNED BY		[Signature] AGENT		
DATE		Jan. 17, 1919.		
ANY ERASURE, ALTERATION, REPEINMENT OR RIVULSION OF THIS ORDER RENDER IT VOID				
		10- AMERICAN EXPRESS CO. MONEY ORDER. BENTLEY'S RECEIPT KEEP IT. AMOUNT OF \$46.25 Cash.		

A postal money order is payable to the order of the party or firm upon identification at the place named in the order, while an express money order is payable to the party or firm upon identification at *any* office of the same company where orders are sold.

RATES FOR POSTAL MONEY ORDERS

\$.01 to	\$ 2.50	3¢
\$ 2.51 to	\$ 5.00	5¢
\$ 5.01 to	\$ 10.00	8¢
\$ 10.01 to	\$ 20.00	10¢
\$ 20.01 to	\$ 30.00	12¢
\$ 30.01 to	\$ 40.00	15¢
\$ 40.01 to	\$ 50.00	18¢
\$ 50.01 to	\$ 60.00	20¢
\$ 60.01 to	\$ 75.00	25¢
\$ 75.01 to	\$ 100.00	30¢

RATES FOR EXPRESS MONEY ORDERS

\$.01 to	\$ 2.50	5¢
\$ 2.51 to	\$ 5.00	7¢
\$ 5.01 to	\$ 10.00	10¢
\$ 10.01 to	\$ 25.00	12¢
\$ 25.01 to	\$ 50.00	15¢
\$ 50.01 to	\$ 75.00	18¢
\$ 75.01 to	\$ 100.00	20¢

I sent \$75.80 to New Orleans, La., by express money order. How much could I have saved by purchasing a bank draft at 15 cents exchange?

TELEGRAPHIC MONEY ORDERS

Such orders are drawn by agents of the telegraph company, and direct the agent at some designated office to pay to the person named in the telegraphic message, upon identification, the sum specified.

The present rates for sending money by telegraphic order are, in addition to the regular charge for a 15-word message between the two places :

For \$25 or less	25¢
Above \$25 and not above \$50	35¢
Above \$50 and not above \$75	60¢
Above \$75 and not above \$100	85¢

After the first \$100, up to and including \$3000, add 20 cents for each \$100 or part thereof.

Find the cost of telegraphic money orders for (1) \$25, (2) \$475, (3) \$80, at the following rates for messages :

1. 15 words, \$1 2. 15 words, 90¢ 3. 15 words, 45¢

COMMERCIAL DRAFTS

Bills may be collected at a distance by commercial drafts of a creditor on a debtor.

A **commercial draft** is a written order by one person directing another to pay a sum of money through a bank, at sight or at a stated time.

\$ 450 ⁰⁰	Chicago, Ill., June 27, 1919
~~~~~At sight~~~~~Pay to	
the order of-----First National Bank, Chicago,-----	
Four hundred fifty ⁰⁰ ~~~~~Dollars	
Value received, and charge to account of	
To Steele Brothers	Harris Brothers
No. 14. Portland, Maine }	Chicago, Ill.

SIGHT COMMERCIAL DRAFT

Steele Brothers, produce dealers, Portland Maine, order from Harris Brothers, Chicago, Ill., 1 carload of No. 1 oats. Harris Brothers ship the carload of oats to Portland to the order of themselves. At the same time they draw a sight draft on Steele Brothers, payable to the order of some Chicago bank, and deposit it, with the bill of lading, for collection. The Chicago bank then mails the draft, together with the bill of lading, to some bank in Portland. The Portland bank notifies Steele Brothers. If the carload of oats is accepted by Steele Brothers, they pay the draft and receive the bill of lading, which entitles them to the oats.

**A bill of lading** is a receipt given by the carrier to the shipper. The goods shipped and their value are described on its face, and on the back of the receipt is stated the contract of shipment.

If Steele Brothers accept the draft, they write across it "Accepted (Date) Steele Brothers." If they refuse to accept it, the Portland bank returns it to the First National Bank of Chicago, and Harris Brothers are notified.

Creditors use sight drafts in the collection of debts due or past due.

**Time Commercial Drafts.** — The draft on p. 182 will be a **time draft** if it reads "Thirty (or sixty or ninety) days after sight" instead of "At sight."

Some time drafts are payable "30 (or 60 or 90) days *after date*," instead of *after sight*.

In collecting by draft, the exchange is always collected on the face, not on the proceeds, of the draft.

**A trade acceptance** is a special form of draft drawn by the seller on the purchaser of goods, and accepted by the purchaser.

Trade acceptances have been authorized by the Federal Reserve Board as a ready means of converting accounts into cash. They contain at the same time an acknowledgment of an obligation arising out of the purchase of goods from the drawer and a promise to pay at a certain time. Such acceptances are readily discounted by banks. They are *two-name paper* because they bear the name of both the drawer and the acceptor.

TRADE ACCEPTANCE			
NO <u>712</u>	NEW YORK <u>June 5, 1919</u>	<u>63,125</u>	
<u>Sixty days</u> AFTER DATE		PAY TO	
THE ORDER OF <u>John Barrow &amp; Co.</u>			
<u>Three thousand and twelve hundred</u>		<u>and twelve</u> DOLLARS	
THE OBLIGATION OF THE ACCEPTOR HEREON IS BASED OUT OF THE PURCHASE OF GOODS FROM THE DRAWER.			
TO <u>W. Cosgrove &amp; Co.</u>	DATE <u>June 5, 1919</u>	PAYABLE AT <u>New York, N.Y.</u>	SIGNATURE <u>John Barrow &amp; Co.</u>
DUE <u>June 5, 1919</u>			

Notice that the above trade acceptance differs from the ordinary accepted time draft chiefly in the statement "The obligation of the acceptor hereof arises out of the purchase of goods from the drawer." W. Cosgrove and Co. have bought goods of John Barrow and Co. on 60 days' time. On receipt of the goods W. Cosgrove and Co. write their *acceptance* across the face of the draft drawn by John Barrow and Co. John Barrow and Co. can then readily discount this draft at a bank, like a note, and thus receive cash in payment of their goods.

1. The Fiske Company, Sandusky, Ohio, draw at sight on James Howard, Canonsburg, Pa., for \$159.70 through the Erie National Bank, Sandusky, Ohio. Write the draft.
2. Write a draft for \$1200 payable thirty days after date.
3. Write a 90-day trade acceptance for \$2000.
4. A sight draft for \$2500 is collected at a cost of  $\frac{1}{10}\%$ . What is the charge for collection?
5. How much does a bank charge for collection of a 90-day time draft for \$215.65 at  $\frac{1}{10}\%$ ?
6. What is the proceeds of a 60-day trade acceptance for \$5000 discounted for the full term at 6%?
7. What is the proceeds of the trade acceptance at the top of this page, if it is discounted on May 1, 1919 at 6%?

## LETTERS OF CREDIT AND TRAVELERS' CHECKS

People intending to travel abroad generally secure a letter of credit or a foreign express check.

A letter of credit is a circular letter issued by an international banking house, authorizing the person securing the letter to draw money on demand, at specified banking houses, or other financial institutions, for any sums not exceeding the face value of the letter.

The purchaser is required to sign several blanks, one of which is sent to each correspondent bank. When he wishes to draw funds, he presents his letter at any one of these banks, and signs a draft or a check for the amount he desires to draw. After comparison of the signature with that on the signature blank, the money is paid and charged on the letter, which is then returned to the owner. A commission of 1% is usually charged by the bank issuing the letter of credit.

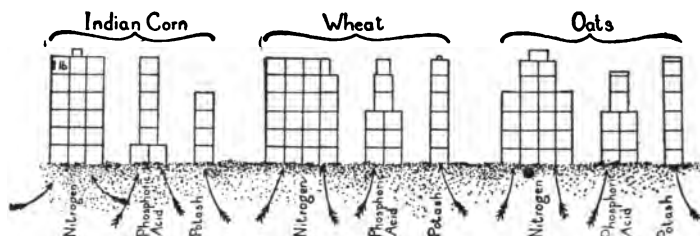
**Travelers' checks** are checks issued in denominations of \$10, \$20, \$50, \$100, and \$200, by banks and express companies, at a fixed rate of  $\frac{1}{2}\%$  of the face value, with a minimum charge of 30 cents. The purchaser signs each check on the face, at the time of purchase, and repeats the signature when he cashes the check. The checks are accepted at all hotels, railroads, shops, etc.

The following values were printed on a \$20 check:

£	s.	d.	FRANCS	MARKS	LIRE	CROWNS	FLORINS
4	1	2	102.50	82.50	102.50	73.39	49.02

1. Find how much English, French, and German money would be received in return for a \$10 check; for a \$50 check. (£ represents pounds; s., shillings; d., pence. 1 s. = 12 d.)

## FARM PROBLEMS



SHOWING THE AMOUNTS OF THE THREE MOST IMPORTANT PLANT FOODS REMOVED FROM THE SOIL BY 1000 POUNDS EACH OF THE GRAIN OF INDIAN CORN, WHEAT, AND OATS.

NOTE. Teachers in city schools who feel that the pupils do not require so many applications of arithmetical principles to farm problems can omit this section without interrupting the sequence.

POUNDS OF FERTILIZING CONSTITUENTS IN ONE TON

MATERIALS	NITROGEN	PHOSPHORIC ACID	POTASH
Timothy hay .	19	16	47
Clover hay . .	39	13	44
Alfalfa hay .	46	13	35
Corn, grain .	34	13	9
Corn, stover .	12	9	39
Bran . . . .	51	62	35
Oat straw . .	13	7	38
Milk . . . .	12	4	3
Butter . . .	1.6	1	1
Farm animals.	53	37	3
Farm manure .	10	5	10

**Plant Foods.**—Nitrogen, phosphoric acid, and potash must be in the soil in sufficient quantities to produce good crops. All other necessary constituents are usually present.

Nitrogen comprises 78 % of the air. The most common method of introducing it into the soil in the eastern states is by planting the ground in clover; in the southern states by planting cowpeas or soy beans; and in the western states by raising alfalfa. Potash and phosphoric acid are usually purchased from dealers.

The composition of farm produce varies greatly, so that the same kind of crop may be almost twice as rich in certain constituents in some cases as it is in other cases. The table shows the average composition of each.

1. How many pounds of nitrogen are there in each of the following: 6 tons clover hay? 3600 lb. grain corn? 5500 lb. timothy hay? 4 tons alfalfa?

2. A farmer cut on an average 3 tons per acre of clover hay from a 5-acre field. How many tons of manure were required for the field to supply the phosphoric acid in the hay?

3. A farmer sold 50 tons of timothy hay in one season. How many tons of farm manure balanced the loss in potash?

4. When nitrogen is worth 16¢ a pound, phosphoric acid 5¢, and potash 6¢, find the fertilizing value of 5 tons of farm manure.

5. A commercial fertilizer when analyzed was found to contain 3.4 % nitrogen, 6.6 % phosphoric acid, and 9 % potash. Find its value per ton, when nitrogen is worth 15¢ a pound, phosphoric acid 3¢ a pound, and potash 5¢ a pound.

6. The analysis of a certain brand of bone meal showed the following: 1.6 % nitrogen and 27.9 % phosphoric acid. What was its value per ton, at 15¢ a pound for nitrogen and 3½¢ a pound for phosphoric acid?

The Bordeaux mixture used for killing fungus growths contains 4 pounds of copper sulphate (blue vitriol) and 4 pounds of stone lime to the barrel (50 gallons).

7. For a vineyard of 25 acres of grapes suffering from black rot of the fruit, how many pounds of sulphate of copper and lime were necessary, if 100 gallons of Bordeaux mixture sprayed  $\frac{2}{3}$  of an acre?

8. If sulphate of copper can be bought at 6¢ a pound, and stone lime at  $\frac{1}{2}$ ¢ a pound, find the cost of materials for 500 gallons of Bordeaux mixture.

9. 1000 bushels of apples from 60 trees, which were not sprayed, were sold as follows: 200 bu. of perfect fruit at \$2 a bushel, and 800 bu. of scabby and wormy fruit at \$.80 a bushel. If spraying the 60 trees at \$.20 a tree caused them to yield 800 bu. of perfect fruit @ \$2 and 200 bu. of wormy fruit @ \$.80, how much was gained by the spraying?

10. The estimated value of a crop of grapes was \$400 an acre. Thorough spraying cost \$6 an acre. If, without spraying, fungus diseases would destroy 30% of the crop, what was the net value of the spraying of 10 acres?

11. The average yield from 4 acres of sprayed grapes was 4770 lb. an acre, and the yield from unsprayed grapes was 3108 lb. The grapes were sold for  $5\frac{1}{2}$ ¢ a pound. The cost of spraying was \$8.60 an acre. What was the net gain on the 4 acres as a result of spraying?

A Paris green solution used for killing chewing insects that destroy the plants by eating the leaves, and for destroying the codling moth, to prevent wormy fruit, is made by mixing 4 ounces of Paris green with 50 gallons of water.

12. An apple orchard of 250 trees was sprayed for the apple worm, with Paris green at 32¢ a pound. Find the cost of the material if 50 gal. of the solution were used to 20 trees.

13. Mr. Wagner sprayed  $8\frac{1}{4}$  acres of potatoes 4 times with Bordeaux mixture containing Paris green, to control blight, rot, and insects. His expense account was as follows: 183 lb. copper sulphate @ 8¢; 204 lb. lime at \$1.50 per hundred; 10 lb. Paris green @ 35¢; 48 hr. labor for a man @ 20¢;



40 hr. labor for a team @ 25¢; wear of sprayer, \$1.50. What was the cost of spraying per application per acre?

14. The  $8\frac{1}{4}$  acres mentioned above yielded 1567.5 bu. potatoes. A portion of the same field that was left unsprayed yielded 156 bu. an acre. The crop was sold for \$1.50 a bushel. What was the net profit an acre as a result of spraying, allowing \$5.16 an acre for spraying?

15. Thirty-four apple trees sprayed to control scab and codling moths yielded 90 bu. merchantable fruit and 32 bu. culls and windfalls. In the same orchard 21 unsprayed trees yielded 11 bu. merchantable fruit and 40 bu. culls and windfalls. The merchantable apples were sold for \$2 a bushel and the culls and windfalls for \$.75 a bushel. The cost of spraying was \$.35 a tree. What was the net gain from spraying per tree?

16. A farmer planted 12 A. with potatoes. His expenses were as follows: Preparing the soil and planting, \$9.50 an acre; gathering and marketing the crop, \$7.50 an acre; seed, \$14 an acre. If his crop averaged 150 bu. to the acre, worth \$1.50 a bushel, what was his profit?

17. What per cent of the total expense was the cost of the seed?

18. A field 40 rd. in width by 80 rd. in length was planted with sweet potatoes. How much did it cost to plow it at \$4 an acre?

19. How much was the crop worth if it averaged 125 bu. to the acre, worth \$1.29 a bushel?

20. A farmer bought a rectangular ten-acre lot, 20 rd. on one side. He put up a fence at \$1.64 a rod. How much did the fence cost?

**21.** The expense for cultivation, fertilizer, and seed was \$200. His crop was 460 bu. of corn worth \$1.30 a bushel. How much, if any, profit did he realize from the first year's use of the field?

**22.** A poultry raiser had a flock of 250 hens. During the year he raised and sold 240 lb. of poultry at an average price of 35¢ a pound. He sold 50 doz. eggs a week at an average price of 40¢. His expense for labor, feed, etc., was \$602. What was his profit?

**23.** If his whole investment amounted to \$775, what per cent did he realize on his investment?

**24.** If 200 hens lay on an average 150 eggs a day, what is the profit for the month of March from 500 hens, eggs being worth 43¢ a dozen and the cost for feeding each hen being 12¢ a week?

**25.** A farmer had a herd of 12 cows, averaging 8 qt. of milk a day each. He received 6 $\frac{3}{4}$ ¢ a quart for his milk. What was his income for the month of June?

**26.** If 500 qt. of this milk made 55 lb. of butter worth 45¢ a pound, what would be the difference in income if the farmer referred to in Ex. 25 had converted his milk into butter, allowing \$32 for labor?

**27.** The quantity of milk consumed by factories in the United States in the manufacture of dairy products was 9,888,727,000 lb. one year and 14.7% less five years later. What was the quantity consumed in the later year?

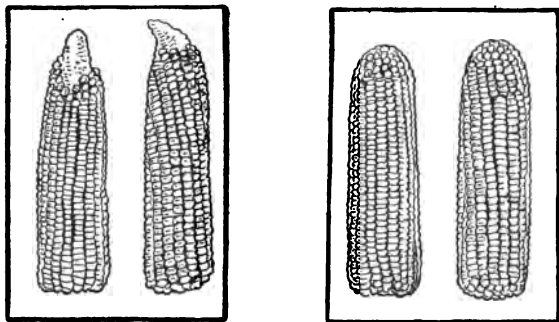
**28.** The quantity of cream increased from 1,406,144,000 lb. one year to 69.5% more five years later. What was the number of pounds in the later year?

**29.** The total value of dairy products increased in five years from \$275,277,000 to \$370,819,000. What was the per cent of increase, to the nearest tenth per cent?

30. The production of condensed and evaporated milk increased in five years from 495,198,000 lb. valued at \$33,587,000 to 884,647,000 lb. valued at \$59,375,000. Find the per cent of increase in quantity and in value.

31. The production of butter increased in five years from 627,146,000 lb. valued at \$180,175,000 to 786,013,000 lb. valued at \$223,179,000. Find the per cent of increase in quantity and in value.

Before Mr. Adams began to improve his corn raising by selected seed, most of the yield was like the first two ears in the picture; but by proper selection of seed, the yield was like the last two ears in the picture.



IMPROVEMENT OF CORN BY SELECTION

32. Mr. Adams's yield in 1919 was 80 bushels of ears per acre. In 1920, on the same land by proper selection of seed, it was increased to 100 bushels of ears per acre. What was the per cent of increase by proper selection of seed?

33. In one year Texas produced about 3,725,000 bales of cotton; Georgia, 1,820,000 bales; Arkansas, 1,134,000 bales; South Carolina, 930,000 bales; Oklahoma, 823,000 bales. The total crop was about 11,443,000 bales. Find the per cent of the total production of each of these states.

34. What per cent of the cotton crop of Texas was the crop of Georgia? What per cent of the crop of Texas was the crop of Arkansas? the crop of South Carolina? the crop of Oklahoma?

35. Mr. Wood planted 50 A. in cotton, which yielded 3 bales of 256 lb. each per acre. How much did he receive for the cotton at 20¢ a pound?

Cowpeas and soy beans are raised not only for food products but also to enrich the soil by the formation of nitrates.

36. Mr. Wood sowed the 50 A. in soy beans and the value of the increased fertility of the soil was 20% of the previous crop. How much was the increased fertility of the soil worth?

37. Mr. Wood estimated that the nitrates necessary to fertilize an acre of land to produce cotton were worth \$6.75,



United States

Rest of world

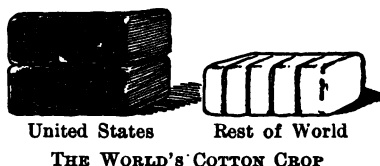
THE WORLD'S WHEAT CROP

and the cowpea stubble \$2.90. What per cent of the nitrates was the cowpea stubble worth?

38. What per cent of the world's wheat crop was produced by the United States in one year as shown in this picture?

39. In 1915 a field of 20 A. yielded  $17\frac{1}{2}$  bu. of wheat an acre. For the next three years the field was in clover. In 1918 the clover was plowed under and the wheat yield the following summer was 25 bu. an acre. What was the per cent of increase? Explain the effect of the clover sod.

40. What per cent of the world's supply of cotton was produced by the United States in one year as represented graphically in this picture?



41. David Long, by proper selection of seed corn for five years, increased his yield of corn from 80 bu. of ears per acre in 1915 to 105 bu. in 1920. Find the per cent of increase.

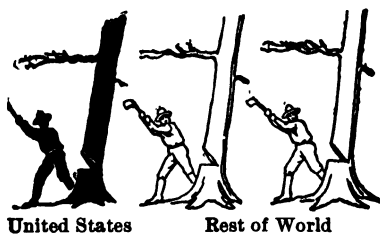
42. William Hackett sowed 10 A. in wheat from the bin and 10 A. in carefully cleaned wheat. The two fields had the same quality of soil and received the same care. The first field yielded 210 bu. and the second field yielded 254 bu. What was the per cent of increase by using carefully cleaned seed?

43. Robert's father gave him 10 trees on which to study scientific fruit raising. The trees one year, without care, yielded small fruit, salable at 30¢ a bushel. Robert pruned the trees and sprayed them for insects that injure the fruit. The next year the trees yielded the same amount of fruit valued at 60¢ a bushel. What was the per cent of increase per bushel by proper care?

44. On a certain plantation the average yield of cotton was 190 lb. an acre; but by seed selection, study of soil, and proper fertilizing, the yield in three years was increased to 392 lb. an acre. What was the per cent of increase by careful farming?

45. A farmer estimated the value of his clover stubble at \$3.90 an acre in nitrates. The clover hay crop was worth \$27 an acre. What per cent of the value of the hay was the value of its stubble?

## FORESTRY AND TREE PLANTING



LUMBERING OF THE WORLD

1. What per cent of the world's lumber supply does the United States produce?

2. Mr. Williams had 50 A. of oak timber which he valued at \$100 an acre when he bought it. If timber has increased  $33\frac{1}{3}\%$  in value, and there has been no damage to the timber, how much per acre should it now be worth?

3. Mr. Long sold his timber tract at \$8 a thousand board feet on the stump. How much did he get from the sale of 150,500 ft. of lumber?

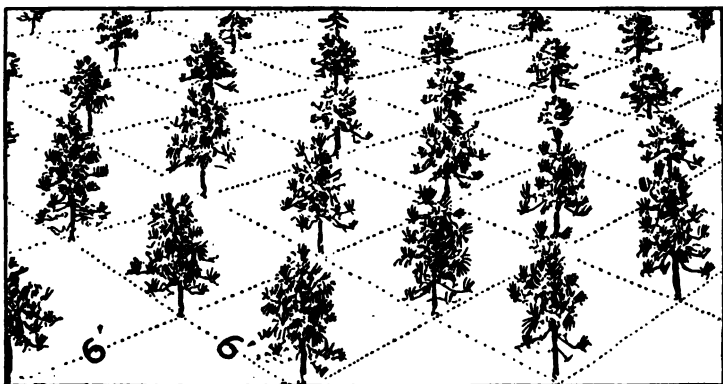
4. Mr. Wayne purchased 160 A. of Washington timber for \$80 an acre. Ten years later he sold it for \$275 an acre. Counting interest for 10 yr. at 6%, how much profit did he realize?

5. Mr. Johnston had 20 A. of second-growth timber, consisting of oak, maple, chestnut, etc. The timber was valued at \$20 an acre when he bought it. If the increase in valuation was 20% a year over each former year, how much was the timber worth three years later?

6. Mr. Ford bought 50 A. of timber land at \$60 an acre, including the timber; 30 yr. later he sold the timber land at \$240 an acre, including the timber. What was the average annual per cent of increase in the timber tract?

## TREE PLANTING FOR TIMBER

**NOTE.** The destruction of our forests is impressing on the people of our country the need of planting trees for timber. The principal trees planted for timber are: *white pine*, planted 6 ft. apart; *southern* or *hard pine*, 4 ft. apart; *black locust*, 6 ft. apart; and *catalpa speciosa* or *hardy catalpa*, 6 ft. apart. When spacing the trees 6 ft. apart, 1200 trees are estimated to the acre; and when spacing the trees 4 ft. apart, 2000 trees to the acre.



This picture shows white pine trees, three years old, set out on soil that originally was covered with white pine forests.

1. How much will it cost to plant 20 A. in white pine trees, if the plants cost \$30 a thousand, and the planting, \$12 an acre?
2. An Indiana farmer planted 30 A. in hardy catalpa. The trees cost \$27 a thousand, and the planting, \$9 an acre. Find the cost of the trees when set out.
3. The estimated value after 20 years, from the white pine trees set out in problem 1, is \$40 an acre. Every 5 yr. thereafter the increase is  $33\frac{1}{3}\%$  over each former period. What is the value of the timber after 40 years' growth?

4. The hardy catalpa mentioned in Ex. 2 is estimated at \$40 an acre after 15 years' growth. If the increase every 5 yr. thereafter is 25 %, what is the value of the catalpa after 30 years' growth?

5. A landowner paid \$750 for 50 A. of land from which the timber had been cut. A white pine forest immediately started to grow; 28 yr. later the value of the pine was estimated at \$35 an acre. The taxes and care for the 28 years cost \$400. If the value of the land remained the same as when it was bought, what per cent profit did the owner make by selling the land and timber after 28 yr.?

6. One year a Virginia farmer cut the oak timber from his land. A natural southern hard pine immediately grew up, which 20 yr. later was worth \$100 an acre. If the land was then worth \$25 an acre, what per cent of the value of the land was the value of the timber?

7. A man bought 160 A. of timber land, in the state of Washington, at \$35 an acre. He sold it, 20 yr. later, at \$245 an acre. If the taxes and care amounted to \$3500, what average annual per cent of profit did he make?

8. Mr. Kirk bought 50 A. of worn-out land in Virginia at \$8 an acre. A natural southern pine forest grew up on this land, which Mr. Kirk sold 40 yr. later at \$60 an acre, including land and timber. Considering the taxes and rental value of this land for 40 yr. at \$20 an acre, what per cent profit did Mr. Kirk make?

9. Mr. Franklin bought 200 A. of land covered with second-growth timber at \$20 an acre. After 10 yr. he sold the land and the timber for \$40 an acre. Allowing \$30 a year for taxes, and 6 % interest on the investment, find the net profit on the investment.



## INDUSTRIAL PROBLEMS

### MANUFACTURING PROBLEMS

The following table gives a comparative summary of manufacturing statistics in 1909 and 1914 for the geographic divisions of the United States:

DIVISION	CENSUS YEAR	NUMBER OF ESTABLISHMENTS	WAGE EARNERS	CAPITAL	WAGES	VALUE OF PRODUCTS
New England	1914	25,193	1,140,233	\$ 2,948,040,000	\$ 628,409,000	\$ 2,926,676,000
	1909	25,351	1,101,290	2,503,854,000	557,631,000	2,670,065,000
Middle Atlantic	1914	85,466	2,355,940	7,836,071,000	1,370,131,000	8,053,644,000
	1909	81,315	2,207,747	6,505,675,000	1,182,568,000	7,141,761,000
East North Central	1914	59,896	1,680,281	5,913,681,000	1,073,538,000	6,542,261,000
	1909	60,013	1,513,764	4,547,225,000	827,152,000	5,211,702,000
West North Central	1914	27,199	381,595	1,424,181,000	235,471,000	2,032,192,000
	1909	27,171	374,337	1,171,572,000	204,792,000	1,803,899,000
South Atlantic	1914	28,925	685,342	1,644,539,000	293,063,000	1,682,999,000
	1909	28,088	663,015	1,368,475,000	244,378,000	1,381,186,000
East South Central	1914	14,410	264,778	713,357,000	117,987,000	700,668,000
	1909	15,381	261,772	586,276,000	102,191,000	630,488,000
West South Central	1914	12,417	211,940	687,819,000	116,128,000	802,538,000
	1909	12,339	204,520	547,739,000	97,646,000	625,443,000
Mountain or Plateau	1914	6,079	81,113	460,971,000	66,358,000	437,568,000
	1909	5,254	75,435	348,977,000	56,870,000	363,996,000
Pacific	1914	16,206	235,515	1,153,321,000	178,247,000	1,067,889,000
	1909	13,579	213,166	848,477,000	153,810,000	843,512,000

1. Find the total number of wage earners in manufacturing industries in the United States in 1914; the total wages in 1914; the average wage for each person.

2. Find the total number of establishments in the United States in 1909 ; in 1914 ; the increase in number.

3. Find the per cent of increase in number of establishments from 1909 to 1914.

4. What was the difference in the amount of capital invested in the United States in 1909 and 1914 ?

5. What was the per cent of increase in the amount of capital from 1909 to 1914 ?

6. Find the total value of the products in the United States in 1909 ; in 1914.

7. Find the per cent of increase in total value of production in the United States from 1909 to 1914.

Find the per cent of increase in the value of products from 1909 to 1914 in :

8. New England.

9. Middle Atlantic States.

10. East North Central States.

11. West North Central States.

12. South Atlantic States.

13. East South Central States.

14. West South Central States.

15. Mountain States.

16. Pacific States.

17. Draw a graph showing the relative rank of the divisions for value of products in 1914.

18. Draw a graph showing the relative amount of capital invested in each division in 1914.

19. Draw a graph showing the relative amount of wages paid in each division in 1914.

The following table shows the condition of the woollen industry in 1909 and 1914 :

INDUSTRY	NUMBER OF ESTABLISHMENTS		VALUE OF PRODUCTS	
	1914	1909	1914	1909
Worsted (combed wool) goods	294	324	\$ 275,668,474	\$ 312,624,663
Woolen (carded wool) goods	501	587	103,815,905	107,118,858
Carpets and rugs . . . .	97	139	69,128,185	71,188,152
Felt goods . . . . .	53	43	13,692,765	11,852,626
Wool-felt hats . . . . .	30	31	1,944,484	4,382,411
Total				

20. Find the totals for each item.

21. What was the total decrease in value in the five years ?

22. Find (to the nearest tenth per cent) the per cent of decrease or increase in the value of each product from 1909 to 1914.

MERCANTILE PROBLEMS

W. V. Garland Company, of Omaha, Nebr., ordered from the Model Furniture Company, of Grand Rapids, Mich., 200 chairs at \$1.50 each ; 150 chairs at \$2 each ; and 12 sideboards at \$28.50 each, discount 20 %, 10 %. Terms 30 days net, 2 % off in 10 days.

1. Write the order for the goods.

2. The bill was paid in 10 days. Make out a receipted bill.

3. The freight and cartage bills were \$30.32. If W. V. Garland Company sold the goods at a profit of 26 %, how much did they receive for them ?

4. If 40% of the profit was used in paying general expenses, such as light, heat, salaries, etc., what was the net profit?

5. What per cent of the original outlay was the net profit?

6. What was the selling price of a bill of goods that cost \$10,000 and was sold at an advance of 16%, with 5% off for cash?

7. On June 17, 1920, The Miller Company, of Baltimore, Md., bought of the Rogers Silk Company, Allentown, Pa., 5 pieces of silk containing 40 yd., 43 yd., 41 yd., 44 yd., and 40 yd., at \$1.75 a yard, discount 5%, terms 5% off in 10 days. Make out the receipted bill if paid June 21, 1920.

8. If the transportation cost \$4.49, what selling price per yard would be an advance of 20% on the whole outlay?

9. The total cost of 208 yd. of silk was \$333. If 168 yd. were sold at \$1.93 and the remainder at \$1.60, less a discount of 25%, what was the profit?

10. If a part of the profit equal to 5% of the original outlay was applied to general expenses, what was the net profit?

11. What per cent of the original outlay was the net profit?

Write and receipt bills for the following:

12. A school board bought of Wyckoff and Jones, New York, N. Y., 53 gross white crayons @ 40¢; 45 gross pens @ 50¢; 65 gross lead pencils @ \$1.60; discount 10%.

13. Robert Hart bought of the Holt Company 4 10'' saws @ 93¢; 1 set bits,  $\frac{1}{4}$ '' to 1'' @ \$4.90; 3 1'' chisels @ 34¢; 2 block planes @ 76¢; discount 10%.

14. William Evans bought of the Scientific Company, 5 magnets @ 50¢; 3 glass tubes with stopcock @ \$1.50; 10 coils for induction @ 55¢; 1 set resistance spools @ \$3; discount 10%; 5 lb. mercury @ \$1 net.

15. Walter Weston bought of the General Book Company 5 "Principles of Economics" @ \$1, less  $\frac{1}{8}$ ; 8 "Elements of Chemistry" @ \$1.25, less  $\frac{1}{8}$ ; 9 "American History" @ \$1.05, less  $\frac{1}{8}$ ; 28 "Choice Readings" @ \$1.50, less  $\frac{1}{8}$ . He returned to the General Book Company, 4 "Elementary Algebra" billed at \$1.12, less  $\frac{1}{8}$ .

16. Henry Curtis bought of the Carter Company 12 electric fans @ \$13; 10 magnetos @ \$9.60; 20 jump-spark coils @ \$3.30; 18 belt-drive magnetos @ \$9.90; discount 10%, 5%. What was the entire outlay for the goods?

### TRANSPORTATION PROBLEMS

1. If the tank of a tank car contained 1000 cu. ft., how many gallons of oil did a train of 10 tank cars transport and what was its value at  $9\frac{1}{2}\phi$  a gallon?

NOTE.  $7\frac{1}{2}$  gallons = 1 cubic foot.

2. How many such cars were required to carry the contents of a tank whose capacity was 30,000 bbl. of 42 gal. each?

3. The cost of a freight locomotive was \$20,000 and of a steel coal car 6% of this sum. What was the value of a train consisting of a locomotive and 25 cars, each containing 50 T. of coal worth \$2.50 a ton?

4. Allowing \$1.75 a ton for handling and \$.90 a ton for freight, for what must this coal be sold in New York to yield a profit of 25%?

5. A train consisted of 3 steel day coaches and 2 steel sleeping cars. The steel day coaches weighed 112,000 lb. each, and the steel sleeping cars 152,000 lb. each. What per cent of the whole weight was the weight of the sleeping cars?

6. A box car 40 ft. long, 8 ft. 6 in. wide, and 8 ft. high, inside measurements, was received in Boston, Mass., loaded with wheat to a depth of 4 ft. 6 in. At 60 lb. to the bushel what was the weight of the wheat? What was the freight charge at 16¢ a hundred?

NOTE. 2150.42 cu. in. = 1 bu.

7. A quantity of wheat which cost \$1.62 a bushel was sold at an advance of  $11\frac{1}{2}\%$  on the cost price. What was the net profit on 1230 bu., allowing \$118 for freight?

8. Find the freight charge on 73,767 lb. of wheat shipped by water at 6¢ a hundred pounds.

9. On a shipment of 600 bales of cotton weighing 288,000 lb., the freight charges were \$1233.36. What was the average weight of a bale of cotton and what was the freight rate per hundred?

10. What were the freight charges on 75,600 lb. of machinery at  $40\frac{1}{4}$ ¢ a hundred?

11. At \$38 a ton, how much did it cost to relay a double track 12 mi. long with steel rails weighing 80 lb. to the yard?

12. A farmer shipped 55,000 lb. of wheat to Chicago, paying 35.8¢ per hundred for freight and  $6\frac{1}{4}$ ¢ per bushel for other expenses. What was the net profit, to the nearest cent, on the shipment if the wheat was sold for \$1.50 a bushel?

13. If the freight charge on potatoes shipped a certain distance was 25.6¢ a hundredweight, find the cost of shipping a carload of 38,000 lb.

14. An agent bought 100 bbl. of flour for Mr. White, at \$9 a barrel. He paid \$50 for freight and \$5 for storage. Mr. White sent the agent \$1045, which included his commission. What was the commission?

## USING LETTERS TO REPRESENT NUMBERS

It is sometimes helpful to use letters, instead of figures, to represent quantities.

For example, the rule for finding interest can be stated as  $i = t \times r \times p$ ,  $i$  representing the number of dollars of interest,  $t$  the number of years in the time,  $r$ , the number of hundredths in the rate, and  $p$ , the number of dollars of principal.

The area of a rectangle can be expressed as  $A = b \times h$ ,  $A$  representing the number of square units in the area,  $b$  the number of units in the base, and  $h$  the number of units in the height, or altitude, of the rectangle.

The circumference of a circle can be expressed as  $C = \pi \times d$ ,  $C$  representing the number of units in the circumference,  $\pi$  ( $\pi$ ), 3.1416, and  $d$ , the number of units in the diameter.

If we have the problem : "What number added to 31 equals 56?" we can represent it as  $31 + ? = 56$ ; or better, we can use a letter, as  $x$ , to represent the **unknown number**.

Thus,  $31 + x = 56$ . This means that 31 added to a number to be found which, for convenience, we call  $x$ , equals 56.

If we represent a quantity by  $a$ , we represent twice the quantity by  $2a$ , four times the quantity by  $4a$ .

If the number of dollars in the principal is represented by  $p$ , 6 times the principal =  $6p$ , 12 times the principal =  $12p$ , etc. If  $p = \$3000$ ,  $4p = \$12,000$ ,  $7p = \$21,000$ , etc.

If  $a$  represents a certain number, one half the number  $= \frac{1}{2}a$  or  $\frac{a}{2}$  ("one half  $a$  or  $a$  divided by 2"); two thirds of the number  $= \frac{2}{3}a$  or  $\frac{2a}{3}$  ("two thirds of  $a$  or  $2a$  divided by 3.") If  $a = 24$ ,  $\frac{2a}{3} = 16$ , and  $\frac{3a}{4} = 18$ .

If  $p$  represents the principal,  $\frac{p}{4}$  represents  $\frac{1}{4}$  the principal,  $\frac{p}{3}$  one third the principal, etc.

If  $p = \$2700$ , what does  $\frac{p}{3}$  equal?

### Oral Work

1. Read the following:  $\frac{1}{2}x$ ,  $\frac{x}{3}$ ,  $\frac{3a}{5}$ ,  $\frac{3}{4}p$ ,  $\frac{2c}{7}$ .
2. How can you represent four fifths of a principal? If  $p = \$1600$ , what does  $\frac{3p}{4}$  equal?
3. If  $c$  represents a certain number, what does  $4c$  represent?  $7c$ ?  $\frac{c}{3}$ ? If  $c = 6$ , what does  $4c$  equal?  $7c$ ?  $\frac{c}{3}$ ?
4. If  $A$  represents area,  $b$  base, and  $h$  altitude, what does the following expression mean:  $A = \frac{b \times h}{2}$ ?
5. If  $\pi$  represents 3.1416,  $d$  diameter, and  $C$  circumference, read the following formula:  $d = \frac{C}{\pi}$ .
6. If the diameter is 10 in., find the circumference by the above formula.



7. If  $a$  represents a certain number, what does  $5a$  represent?  $2a$ ?  $\frac{a}{4}$ ?  $\frac{3a}{4}$ ?

8. If  $a$  equals 12, what does  $2a$  equal?  $5a$ ?  $\frac{a}{4}$ ?

9. If  $w$  represents the weight of a bushel of grain, what does  $10w$  represent?  $12w$ ?  $\frac{w}{5}$ ?  $\frac{w}{3}$ ?  $\frac{3w}{8}$ ?  $\frac{4w}{5}$ ? If  $w$  equals 40 lb., what does  $5w$  equal?  $\frac{w}{5}$ ?  $\frac{3w}{5}$ ?  $\frac{3w}{8}$ ?

10. If  $x$  represents the number of years in the age of a man, what does  $3x$  represent?  $\frac{x}{6}$ ?  $\frac{3x}{7}$ ? If  $x = 42$ , what does  $2x$  equal?  $\frac{x}{7}$ ?  $\frac{5x}{6}$ ?

11. If  $x$  represents the number of years in the age of John, and Henry is twice as old, how can you represent Henry's age? If George is half as old, how can you represent his age?

12. If  $d$  represents the number of miles between two cities, how can you represent the distance between two cities 5 times as far apart?  $\frac{1}{4}$  as far apart?  $\frac{2}{3}$  as far apart?

13. If  $d$  represents the number of miles from New York to San Francisco, and Chicago is  $\frac{3}{10}$  as far from New York, how can you represent the distance from New York to Chicago?

14. If  $s$  represents the number of miles per hour that a train travels, what is the number of miles per minute that it travels?

15. If  $a$  represents the number of years in the age of John, and David is 6 yr. older, how can you represent the age of David?

If  $x$  represents the number of years in John's age, and  $x + 5$  the number of years in Paul's age, how much older is Paul than John? If Mary's age is represented by  $x + 3$ , how much older is Mary than John? how much younger than Paul? If Henry's age is  $x - 8$ , is he older or younger than John? how much?

16. Represent the number of miles a railroad train travels per hour by  $s$ . If another train runs 10 mi. faster, how can you represent its speed? If still another train runs 9 mi. slower, how can you represent its speed?

17. Represent the number of dollars a house is worth by  $x$ . How can you represent the cost of a house worth \$500 more? \$200 less?

18. Represent the number of pounds in a load of hay by  $w$ . If the wagon weighs 1500 lb. less, what would represent its weight?

19. Represent the number of years in John's age by  $n$ . Represent his age 12 yr. from now; 12 yr. ago.

20. If Henry is twice as old as John, how can you represent his age? If he is 3 yr. more than twice as old, how can you represent his age?

21. Let  $x$  be the number of bushels of wheat in a bin. If 9 bu. are taken out and afterwards 12 bu. are put in, how can you represent the resulting quantity?

$x$  = number of bushels in bin.

$x - 9$  = remainder after taking out 9 bu.

$x - 9 + 12$  = quantity after putting in 12 bu.

That is, the original quantity, less what is taken out, plus what is put in =  $x - 9 + 12$ .

22. Let  $x$  represent the number of pupils in a class; 25 are promoted from the class and 37 are then promoted into it. Represent the number in the class after promotions.

• 23. If a number is represented by  $x$ , how can you express twice the number increased by 40?

24. If John is  $x$  years old and George is  $\frac{1}{3}$  as old, how can you represent the sum of their ages?

$x$  = the number of years in John's age.

$\frac{x}{3}$  = the number of years in George's age.

$x + \frac{x}{3}$  = the number of years in the sum of their ages.

25. If Peter travels  $x$  miles and Edward  $\frac{1}{3}$  as many miles, how can you represent the distance they both travel?

26. If a train runs  $x$  miles in one hour, and  $\frac{3}{4}$  as far the second hour, how can you represent the distance the train travels in the two hours?

27. If a grocer sells  $x$  pounds of butter on Monday, and  $\frac{7}{8}$  as much on Tuesday, represent the amount he sells on both days.

28. If there are  $x$  girls in a class, and  $\frac{1}{2}$  as many boys, represent the whole number of pupils in the class.

29. Suppose there are  $x$  boys in a class and  $\frac{3}{4}$  as many girls, how can you represent the whole number of pupils in the class?

30. If there are  $x$  bushels of grain in one bin and 25% as much in another bin, how can you represent the grain in the second bin? (Remember that 25% equals  $\frac{1}{4}$ .)

31. If a horse costing  $x$  dollars is sold at a gain of  $33\frac{1}{3}\%$ , how can you represent the gain?

32. A wagon bought for  $x$  dollars is sold at a gain of 25%. Represent the selling price.

33. A wagon bought for  $x$  dollars is sold at a loss of 25%. Represent the selling price.

## Written Work

Let  $a = 36$ .

$b = 28$ .

$c = 48$ .

$x = 50$ .

$y = 64$ .

$z = 100$ .

What will be the values of the following?

1.  $2a$

9.  $x + 10$

20.  $4x - x - 16$

2.  $3b$

10.  $x - 10$

21.  $x + \frac{x}{3}$

3.  $5c$

11.  $2a + 4$

22.  $2a + \frac{2a}{3}$

4.  $7x$

12.  $3c - 6$

23.  $b + \frac{b}{4}$

5.  $\frac{x}{2}$

13.  $3x + 20$

14.  $2a + 3a$

24.  $2z + \frac{3z}{5}$

6.  $\frac{3y}{4}$

15.  $c + 2c$

16.  $2b - b$

25.  $\frac{2y}{4} + \frac{3y}{8} + 5$

7.  $\frac{2c}{3}$

17.  $5x - x$

18.  $6y - 2y$

26.  $\frac{3x}{10} + \frac{6x}{12} - 7$

8.  $\frac{5a}{6}$

19.  $3a - 2a + 10$

## THE EQUATION

## Oral and Written Work

1.  $8 + 4 = 12$

5.  $i = t \times r \times p$

2.  $9 = 12 - 3$

6.  $A = \frac{b \times h}{2}$

3.  $5 + 7 = 4 + 8$

7.  $x + 6 = 9$

4.  $15 - 5 = 3 + 7$

8.  $x - 10 = 4$

Each of these expressions is an equation because it states that one quantity or combination of quantities is equal to another quantity or combination of quantities.

The part of the equation on the left of the equality sign is called the **first member** of the equation and the part on the right is called the **second member**.

$i$  is the first member of equation (5),  $x + 6$  of equation (7);  $t \times r \times p$  is the second member of (5) and 9 of (7).

What is the first member of each of the other equations? the second member?

9.  $18 + 6 - 3 = ?$

12.  $? = 14 + 4 - 4$

10.  $15 + 5 - 5 = ?$

13.  $? = 24 + 8 + 2$

11.  $20 - 8 + 12 = ?$

14.  $? = 10 - 32 + 32$

Complete (9) (10) (11) by writing the second member. Complete (12) (13) (14) by writing the first member.

Several important facts about equations may be learned by studying equations (1) (2) (3) (4) on p. 208. If you add 4 to the first member of (1), it is evident that you must add 4 also to the second member or else the two members will no longer be equal. Thus, if you write  $8 + 4 + 4 = 12$ , the members are not equal.

Prove also with (2) (3) (4) that *if the same number is added to both members, the members remain equal.*

In the same way it is evident that *if the same number is subtracted from both members, the members remain equal.*

Thus, subtract 3 from each member of (1) and you have  $8 + 4 - 3 = 12 - 3$ . Prove the rule with (2) (3) and (4).

If you multiply both members of (1) by 2, the equation will be  $16 + 8 = 24$ . The members are still equal. *If both members of the equation are multiplied by the same number, the members remain equal.*

Multiply both members of (2) by 4.

If you divide both members of (1) by 4, the equation is  $2 + 1 = 3$ . *If both members of an equation are divided by the same number, the members remain equal.*

Divide the members of (2) by 3.

You have now discovered these important rules relating to equations:

*The same number may be added to both members of an equation without destroying the equality.*

*The same number may be subtracted from both members of an equation without destroying the equality.*

*Both members of an equation may be multiplied by the same number without destroying the equality.*

*Both members of an equation may be divided by the same number without destroying the equality.*

Knowing these facts and employing letters to represent quantities whose value is unknown, you can, by means of the equation, solve many problems.

**How to solve equations by addition or subtraction.**

### Written Work

1. What number added to 67 equals 96?  $x + 67 = 96$ .  
That is, an unknown number added to 67 equals 96.

Subtract 67 from both members. The equation then is

$$x + 67 - 67 = 96 - 67.$$

$x + 67 - 67$  is simply  $x$ , as the 67 subtracted cancels the 67 added.

Therefore  $x = 96 - 67$ , or 29.

The required number is 29.

2. What number added to 49 equals 93?

Let  $x$  represent the number you wish to know.

The problem may now be put in the form of an equation.

$$x + 49 = 93.$$

Subtract 49 from both members and the equation becomes

$$x + 49 - 49 = 93 - 49$$

$$x = 93 - 49$$

$$x = 44.$$

The required number is 44.

Find the value of  $x$  in the following equations:

3.  $6 + x = 10$

5.  $8 + x = 20$

4.  $x + 4 = 12$

6.  $x + 9 = 16$

Find the value of  $x$  in the equation:

7.  $x - 8 = 4$

Add 8 to each member and you have  $x - 8 + 8 = 4 + 8$ , or  $x = 12$ .

Find value of  $x$  in the following equations:

8.  $x - 3 = 10$

10.  $30 = x - 10$

9.  $x - 12 = 18$

11.  $x - 40 = 75$

Finding the value of  $x$ , or the unknown number, is called **solving an equation**.

Solve these equations:

12.  $5 + x = 12$

17.  $36 + x = 50$

13.  $7 + x = 15$

18.  $x + 27 = 45$

14.  $x + 12 = 20$

19.  $100 + x = 125$

15.  $x - 3 = 10$

20.  $90 + x = 120$

16.  $40 = x + 10$

21.  $75 + x = 100$

**How to solve equations by division.**

### Written Work

1. The second of two numbers is 3 times the first number and their sum is 48. Find the numbers.

Let  $x$  = the first number.

Then  $3x$  = the second number.

$x + 3x$  = the sum of the numbers.

That is,  $x + 3x = 48$ .

$x + 3x = 4x$ .

Hence  $4x = 48$ .

Therefore  $x = 12$ , the first number. (Dividing both members by 4.)

$3x = 36$ , the second number.

2. A walks a certain number of miles in a day, B walks twice as far, and C walks three times as far. In all they walk 60 miles. How far does A walk?

Let  $x$  = the number of miles A walks.

Then  $2x$  = the number of miles B walks,

and  $3x$  = the number of miles C walks.

Hence  $x + 2x + 3x = 60$ .

$x + 2x + 3x = 6x$ .

Therefore  $6x = 60$ .

$x = 10$ , the number of miles A walks. (Dividing both members by 6.)

Find the value of the unknown quantity in each equation:

- |                     |                            |
|---------------------|----------------------------|
| 3. $5x = 25$        | 12. $9x - x = 48$          |
| 4. $8x = 64$        | 13. $x + 4x + 3x = 96$     |
| 5. $3x = 165$       | 14. $x + 5x + x = 63$      |
| 6. $15x = 90$       | 15. $x + 3x - 2x = 20$     |
| 7. $5x + x = 54$    | 16. $15x - 4x + 7x = 90$   |
| 8. $3y + 4y = 49$   | 17. $12y - 3y + 2y = 88$   |
| 9. $5z - 3z = 60$   | 18. $8z + 4z - 3z = 81$    |
| 10. $12y - 3y = 63$ | 19. $14y - 12y + 8y = 100$ |
| 11. $15z - 4z = 77$ | 20. $16x + 3x - 7x = 84$   |

How to transpose from one member to another.

### Oral Work

- |                  |                  |
|------------------|------------------|
| 1. $8 = 12 - 4$  | 4. $9 + 7 = 16$  |
| 2. $15 = 10 + 5$ | 5. $16 - 5 = 11$ |
| 3. $14 - 8 = 6$  | 6. $18 + 3 = 21$ |

Add 4 to each member of (1) and you have  $8 + 4 = 12 - 4 + 4$ , or  $8 + 4 = 12$ . That is, the 4 has been transposed from the second member to the first and its sign has been changed from  $-$  to  $+$ .



Subtract 5 from both members of (2) and you have  $15 - 5 = 10$ . That is, subtracting 5 from each member gives the same result as *transposing* 5 from the second member to the first and changing its sign from + to -.

Add 8 to both members of (3), subtract 7 from both members of (4), add 5 to both members of (5), subtract 3 from both members of (6) and you have results as follows:

(3)  $14 - 8 = 6$ ; adding 8 to both members gives  $14 = 6 + 8$

(4)  $9 + 7 = 16$ ; subtracting 7 from both members gives  $9 = 16 - 7$

(5)  $16 - 5 = 11$ ; adding 5 to both members gives  $16 = 11 + 5$

(6)  $18 + 3 = 21$ ; subtracting 3 from both members gives  $18 = 21 - 3$

It is evident that adding or subtracting a quantity from each member is the same as *transposing* the quantity from one member to the other and changing its sign.

*We may therefore transpose any quantity from one member of an equation to another if we change its sign.*

This is called **transposition**.

### Oral Work

Find the value of  $x$  in the following equations, using transposition:

1.  $x - 6 = 10$

Transposing 6 gives

$$x = 10 + 6; x = 16.$$

2.  $2x + 8 = 24$

Transposing 8 gives

$$2x = 24 - 8; 2x = 16; x = 8.$$

3.  $4x + 3 - 2x = 15$

Transposing 3 gives

$$4x - 2x = 15 - 3; 2x = 12; x = 6.$$

## Written Work

Find the value of  $x$  in the following equations :

- |                   |                          |
|-------------------|--------------------------|
| 1. $x + 20 = 30$  | 12. $9x - 5 = 22$        |
| 2. $x - 16 = 32$  | 13. $7x - 6 = 29$        |
| 3. $x - 12 = 3$   | 14. $3x + 2x + 4 = 34$   |
| 4. $x + 8 = 15$   | 15. $6x + 5x - 6 = 126$  |
| 5. $x - 9 = 27$   | 16. $x + 3x + 2 = 50$    |
| 6. $x + 14 = 20$  | 17. $6x - 2x + 4 = 112$  |
| 7. $x - 40 = 60$  | 18. $8x - 5x - 6 = 93$   |
| 8. $x + 35 = 65$  | 19. $5x - 4 + 3x = 100$  |
| 9. $x - 42 = 18$  | 20. $6x + 7 - 2x = 99$   |
| 10. $2x + 4 = 16$ | 21. $10x - 5 - 4x = 97$  |
| 11. $5x + 3 = 28$ | 22. $12x + 5 + 7x = 100$ |

$$23. 4x + 10 = 82 - 2x$$

In Ex. 23 it is necessary to transpose two quantities. We transpose  $2x$  to the first member, so that all the quantities containing  $x$  may be in one member, and we transpose 10 to the second member so that the quantities not containing  $x$  may be in the other member. The equation then is :

$$4x + 2x = 82 - 10$$

$$6x = 72$$

$$x = 12$$

- |                         |                         |
|-------------------------|-------------------------|
| 24. $4x + 5 = 65 - 2x$  | 28. $6x - 12 = 13 + x$  |
| 25. $8x - 10 = 6x + 20$ | 29. $10x + 5 = 53 - 6x$ |
| 26. $4x + 1 = 100 - 5x$ | 30. $12x - 2 = 8x + 22$ |
| 27. $9x - 4x = 56 - 2x$ | 31. $15x + 5 = 145 - 5$ |

$$32. 10x + 4x - 2x = 16 + 2x + 14$$

# How to solve equations by multiplication.

## Written Work

If you have the equation  $\frac{x}{2} = 5$  and multiply both members by 2, you get  $\frac{x}{\cancel{2}} \times \cancel{2} = 5 \times 2$ , or  $x = 10$ .

If you have  $\frac{3x}{5} = 12$  and multiply both members by 5, you get  $\frac{3x}{\cancel{5}} \times \cancel{5} = 12 \times 5$ ;  $3x = 60$ ;  $x = 20$ .

Find the value of  $x$  in the following equations, by multiplying both members by the denominator of the fraction :

1.  $\frac{x}{3} = 20$

4.  $\frac{x}{2} = 2$

7.  $\frac{2x}{3} = 6$

2.  $\frac{x}{4} = 13$

5.  $\frac{3x}{5} = 36$

8.  $\frac{9x}{2} = 18$

3.  $\frac{x}{5} = 18$

6.  $\frac{8x}{3} = 24$

9.  $\frac{2x}{5} = 10$

10. A coat costs  $\frac{1}{2}$  as much as a suit and a dress  $\frac{2}{5}$  as much. The coat and the dress together cost \$45. What is the cost of the suit?

Let  $x$  = the number of dollars the suit costs.

Then  $\frac{x}{2}$  = the number of dollars the coat costs,

and  $\frac{2x}{5}$  = the number of dollars the dress costs.

The cost of the coat and the dress together is \$45, hence

$$\frac{x}{2} + \frac{2x}{5} = 45 \text{ (Multiply both members by the l. c. d., 10.)}$$

$$\frac{x}{\cancel{2}} \times \frac{5}{\cancel{5}} = 5x.$$

$$\frac{2x}{\cancel{5}} \times \frac{2}{\cancel{2}} = 4x.$$

$$45 \times 10 = 450.$$

The equation is  $5x + 4x = 450.$

$$9x = 450.$$

$$x = 50, \text{ the number of dollars the suit costs.}$$

11. Solve the equation  $\frac{3x}{4} + \frac{5x}{8} = 22$ .

(As the least common denominator is 8, multiply both terms by 8.)

$$\frac{3x}{4} \times \frac{2}{1} \times 8 = 6x$$

$$\frac{5x}{8} \times 8 = 5x$$

$$22 \times 8 = 176$$

$$\text{The equation is } 6x + 5x = 176$$

$$11x = 176$$

$$x = 16$$

In all such problems, multiply both members by the least common denominator of the fractions.

Find the value of  $x$  in the following equations:

12.  $\frac{x}{3} + \frac{x}{2} = 10$

17.  $\frac{x}{3} - \frac{x}{6} = 9$

22.  $\frac{5x}{8} + 3 = 13$

13.  $\frac{x}{3} + \frac{x}{4} = 21$

18.  $\frac{3x}{8} - \frac{x}{4} = 12$

23.  $\frac{3x}{7} + 2 = 5$

14.  $\frac{x}{2} + \frac{x}{5} = 14$

19.  $\frac{5x}{6} - \frac{2x}{3} = 2$

24.  $\frac{5x}{6} - 4 = 6$

15.  $\frac{x}{2} + \frac{2x}{3} = 35$

20.  $\frac{2x}{7} - \frac{x}{14} = 9$

25.  $\frac{3x}{8} - 5 = 1$

16.  $\frac{3x}{4} + \frac{2x}{3} = 17$

21.  $\frac{2x}{3} + 4 = 12$

26.  $\frac{x}{2} - 2 = 4$

27.  $\frac{2x}{3} + \frac{x}{2} + 3 = 10$

31.  $\frac{3x}{4} + \frac{3x}{5} = 35 - \frac{2x}{5}$

28.  $\frac{3x}{4} + \frac{x}{3} - 5 = 8$

32.  $\frac{5x}{6} - 6 = \frac{5x}{9} + 4$

29.  $\frac{5x}{6} - 2 + \frac{x}{3} = 5$

33.  $7 = \frac{2x}{3} - \frac{x}{5}$

30.  $\frac{2x}{3} + 3 = 14 - \frac{x}{4}$

34.  $2x - 8 = \frac{2x}{3}$

35. Express the proportions in Ex. 1-12, p. 142, as fractions and solve the equations.

Thus,

Ex. 1,  $\frac{36}{6} = \frac{24}{x}$ .    Ex. 2,  $\frac{15}{25} = \frac{x}{40}$ .    Ex. 4,  $\frac{75}{x} = \frac{90}{18}$ .    Ex. 6,  $\frac{x}{30} = \frac{8}{48}$ .

Solution to Ex. 1. The l. c. d. is  $6x$ ;  $36x = 144$ ;  $x = 4$ .

### PROBLEMS

1. What number added to 5 times itself equals 84?

Let  $x$  = the number.

Then  $5x = 5$  times the number.

$$x + 5x = 84.$$

$$6x = 84.$$

$$x = 14, \text{ the number required.}$$

2. What number increased by 4 times itself equals 125?

3. Two horses cost \$1200. What was the cost of each, if one cost three times as much as the other?

4. 450 A. of land were divided among three sons. The second received twice as much as the first, and the third received three times as much as the first. How many acres did each receive?

5. Three men went into business with a capital of \$6300. The second furnished twice as much as the first, and the third furnished twice as much as the second. How much did each man furnish?

6. Separate 288 into two parts, one of which is 3 times the other.

7. The sum of two numbers is 625, and the larger number is 4 times the smaller. What are the numbers?

8. Martha spent twice as much for her hat as her brother John spent for his. Both hats together cost \$7.50. What was the cost of each?

9. The difference between two numbers is 96, and the larger number is 4 times the smaller. What are the numbers?

10. There are  $180^\circ$  in the three angles of a triangle. If the second angle is twice as large as the first and the third angle, 3 times as large as the second, how large is each angle?

11. Twice a certain number increased by 36 is equal to 92. What is the number?

12. Multiply any number by 5; add 5; divide by 5; subtract 1. Show that you have the original number.

13. The sum of two numbers is 80, and the smaller is  $\frac{3}{5}$  of the larger. What are the numbers?

Let  $x$  = the larger number.

Then  $\frac{3x}{5}$  = the smaller number,

$$\text{and } x + \frac{3x}{5} = 80.$$

$5x + 3x = 400$  (Multiplying both members by 5.)

$$8x = 400.$$

$x = 50$ , the larger number,

$$\frac{3x}{5} = \frac{3 \times 50}{5} = 30, \text{ the smaller number.}$$

14. The sum of two numbers is 95 and one number is  $\frac{2}{3}$  of the other. What are the numbers?

15. What number increased by  $\frac{3}{4}$  of itself is equal to 77?

16. On a stormy day only  $\frac{7}{8}$  of the pupils were present at school. There were 210 pupils present. What was the total register?

17. When Mr. Hunt's salary was increased by  $\frac{1}{3}$  it was \$2400. What was his salary before the increase?

18. If a bill amounted to \$80 after deducting a discount of 20%, how much was it without the discount?

19. The difference between two numbers is 55 and the smaller number is  $\frac{3}{8}$  of the larger. What are the numbers?

20. When a certain number is diminished by  $\frac{7}{8}$  of itself, it becomes 35. What is the number?

21. A baseball team won 15 games, which were 60 % of the number played. How many were played?

22. The sum of two numbers is 10 and the smaller is  $\frac{1}{4}$  of the larger. What are the two numbers?

23. A man spent 65 % of his yearly salary, or \$1300, for food, shelter, and clothing. What was his salary?

24. A rectangle is 3 times as long as it is wide. Its perimeter is 16 in. Find its length and its width.

25. Divide 120 into two parts, one of which shall be 2 times the other.

26. If \$500 was paid for a horse and a wagon, the wagon costing  $\frac{2}{3}$  as much as the horse, what was the cost of each?

27. A skating rink accommodated 4900 persons. One day there were  $\frac{2}{5}$  as many skaters as spectators. How many were there of each?

28. The second of three lines is twice as long as the first; the third is three times as long as the first. If the sum of the lengths of the three lines is 24 in., how long is each line?

29. A wagon loaded with hay weighed 4500 lb. The wagon weighed 1500 lb. less than the hay. Find the weight of each.

30. The sum of three numbers is 270. The second is double the first, and the third is twice the sum of the other two. What are the numbers?

31. In a certain school there were  $\frac{5}{8}$  as many boys as girls, and the girls exceeded the boys in number by 50. How many pupils were there in the school?

32. Divide 25 into two parts, the smaller of which shall be  $\frac{2}{3}$  of the larger.

33. Three men owned 230 A. of land. The share of the second was 10 A. less than that of the first, and the share of the third was 20 A. less than that of the second. Find the share of each.

34. The perimeter of a rectangular field 60 rd. wide is 300 rd. What is its length?

35. A rectangular field twice as long as it is wide has a perimeter of 480 rd. Find its dimensions.

36. Divide \$550 among three persons, giving to the first  $\frac{1}{2}$  as much as to the second and to the third  $\frac{1}{3}$  as much as to the second.

37. After paying  $16\frac{2}{3}\%$  and  $25\%$  of my debts, I still owed \$35. How much did I owe at first?

38. A horse was sold for \$320, the seller thereby gaining  $60\%$  of what he paid for it. What was the cost of the horse?

39. A man who spent each year  $15\%$  of his salary for clothing and  $60\%$  for board and other expenses, saved \$840. What was his salary?

40. A farmer paid for a cow  $25\%$  of what he paid for a horse. How much did he pay for each, if the horse cost \$240 more than the cow?

41. The interest on a sum of money for 2 yr. at  $6\%$  is \$120. What is the principal?

42. At what rate will \$200 yield \$20 interest in 2 yr.?

43. In what time will \$1000 yield \$180 interest at  $6\%$ ?

44. The price of apples increased  $33\frac{1}{3}\%$  from last year. This year the price is \$3.20 a barrel. What was last year's price?



# EVERYDAY USE OF NUMBERS

## Weekly Time Records

The hours in a business are from 8 A. M. to 12 M. and from 1 P.M. to 5 P.M. If a workman enters late, his time is counted on the quarter hour after he enters. If he leaves before time, it is counted to the last quarter hour.

Thus, if he enters at 8.01 A. M., his time is counted from 8.15 A. M.; if he enters at 8.16 A. M., his time is counted from 8.30 A. M., etc. If he leaves at 11.40 A. M., his time is counted to 11.30 A. M. If he leaves at 4.55 P. M., his time is counted to 4.45 P. M.

Follow the first card as a model and find in the other three cards the daily and weekly totals of hours and the total weekly wages.

1.

WEEK ENDING MARCH 8, 1919					
No. 158					
Name PAUL DUNN					
DAY	MORNING		AFTERNOON		TOTAL HOURS
	IN	OUT	IN	OUT	
Mon.	8.00	12.00	1.00	5.00	8
Tue.	7.45	12.10	12.50	4.55	7½
Wed.	7.55	11.45	12.55	5.00	7½
Thu.	8.00	12.05	1.00	5.00	8
Fri.	9.00	12.00	12.50	5.00	7
Sat.	7.54	12.05	1.00	5.00	8
Total weekly time, 46½ hours.					
Rate per hour, 50¢.					
Total weekly wages, \$23.25.					

2.

WEEK ENDING MARCH 15, 1919					
No. 205					
Name ARTHUR BRUCE					
DAY	MORNING		AFTERNOON		TOTAL HOURS
	IN	OUT	IN	OUT	
Mon.	7.45	12.00	12.55	5.00	
Tue.	8.00	12.10	12.53	4.30	
Wed.	9.30	12.00	12.56	5.10	
Thu.	8.00	12.06	1.00	5.00	
Fri.	7.50	12.00	12.59	5.00	
Sat.	8.00	12.09	12.55	4.15	
Total weekly time,					
Rate per hour, 60¢.					
Total weekly wages,					

3.

WEEK ENDING MARCH 15, 1919					
No. 187					
Name JAMES MASON					
DAY	MORNING		AFTERNOON		TOTAL HOURS
	IN	OUT	IN	OUT	
Mon.	7.50	12.00	1.00	5.00	
Tue.	8.00	12.05	12.58	5.06	
Wed.	8.10	12.04	12.55	5.07	
Thu.	7.45	12.03	12.54	5.08	
Fri.	8.00	12.02	12.53	4.00	
Sat.	9.30	12.01	1.00	5.00	
Total weekly time,					
Rate per hour, 60¢.					
Total weekly wages,					

4.

WEEK ENDING MARCH 15, 1919					
No. 194					
Name DAVID EASTON					
DAY	MORNING		AFTERNOON		TOTAL HOURS
	IN	OUT	IN	OUT	
Mon.	7.59	12.00	1.00	5.00	
Tue.	7.45	12.00	12.50	4.10	
Wed.	8.00	12.09	12.56	5.00	
Thu.	7.55	12.08	12.55	5.05	
Fri.	7.48	12.06	12.54	5.03	
Sat.	8.30	12.05	12.53	4.40	
Total weekly time,					
Rate per hour, 55¢.					
Total weekly wages,					

### Good Roads

1. What was the total cost of building a macadam road 15 ft. wide and  $3\frac{1}{2}$  mi. long at \$1.50 a square yard?

2. In the United States 350,000,000 tons of freight were hauled one year over public roads at a cost of \$.23 per ton per mile. The average haul was 8 mi. Find the total annual cost.

3. It cost Mr. Fox 6.4¢ a bushel to haul his wheat 9.4 mi. over a bad road from his farm to the nearest railroad station. What was the cost per mile?

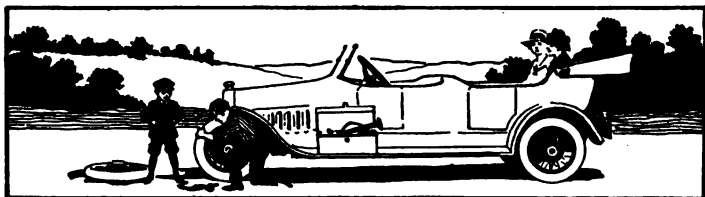
4. The construction of a macadam road reduced the cost of hauling the wheat from 6.4¢ a bushel to 3.1¢ a bushel. How much did Mr. Fox save on hauling 2400 bu. of wheat?

5. Mr. Fox owned 156 A. of land valued at \$75 an acre. The new road increased the value of his land by  $13\frac{1}{8}\%$ . What was the total value after the increase?

6. One year the unimproved farm land in the United States was 400,346,575 A. If the construction of good roads should increase the value by \$9.76 an acre, how much would it add to the value of the farm land in the country?

7. A horse that could draw 2000 lb. on a level road could draw only 1800 lb. when the grade was 1% (1 ft. rise to 100 ft.); 1600 lb. when it was 2%; 800 lb. on a 5% grade; and 500 lb. on a 10% grade. What was the per cent of decrease for each grade as compared to a level road?

8. It took 2 horses to haul a given load on a macadam road, 10 horses on an earth road, and 30 horses on a sand road. What per cent of energy was saved by converting a dirt road into a macadam road? by converting a sand road into a macadam road?



### Running an Automobile

1. An automobile cost \$1100 and depreciated 50% the first year, 20% of the reduced value the second year, and 20% of the third value the third year. What was its value at the end of the third year?

2. This car traveled 180 mi. on 8 gal. of gasoline @ \$.28. Find the number of miles per gallon and the cost per mile.

3. Each of the four tires cost \$25 and was guaranteed to go 6000 mi. What was the tire cost per mile for the trip of 180 mi.?

4. The depreciation of the car amounted to \$.03 $\frac{1}{2}$  a mile, the cost of the oil to \$.005 a mile, and gasoline and tires, as in Ex. 2 and 3. What was the total car cost of the trip of 180 mi.?

5. Four passengers traveled in the car on this 180-mile trip. What would have been the difference in the cost if they had gone by rail at \$.03 a mile?

6. If a car purchased for \$950 was worth only \$600 at the end of a year, what was the per cent of depreciation?

7. A tire cost \$24.70, less 10% for cash. It traveled 5860 mi. What was the tire cost per mile, to the nearest mill?

8. How much did the speedometer register when four tires had traveled 7652 mi., 8276 mi., 6124 mi., 6739 mi., and the spare tire 6105 mi.? (Remember that the mileage was registered by only 4 wheels revolving at a time.)

### The Value of an Education

1. John left school at 14 and earned on an average \$1000 a year for 40 yr. James graduated from high school and earned on an average \$2000 a year for 36 yr. How much more than John did James earn in all? How much was this for each day spent in high school in 4 yr. of 190 da. each?

2. A boy earning \$12.50 a week entered a vocational night school. After graduating he received \$20.50 a week. By what per cent was his salary increased?

3. At the age of 25 Ruth Steele, who had graduated from high school, was earning \$25 a week while her cousin, Anna Ford, who began work at the age of 16, was earning only \$15 a week. What per cent of Ruth's salary was Anna's? What per cent of Anna's was Ruth's?

4. A man who was earning \$15.75 a week received  $66\frac{2}{3}\%$  more after studying for one year at a technical school. What was his salary for a year (52 wk.) after the increase?

5. Out of 5,000,000 uneducated men only 31 obtained a place in a list of 8000 leaders in the United States. What per cent was this?

6. Out of 33,000,000 people with a common school education 808 were in the list of leaders. Find the per cent.

7. Out of 2,000,000 people with a high school training 1245 appeared in the list. Find the per cent.

8. Out of 1,000,000 people with college or university training 5768 won distinction as leaders. Find the per cent.

9. A college graduate earned \$1000 in the first year, then \$1200, \$1500, \$1900, \$2300, \$2700, \$2800, \$3000, \$3500, and \$4000. Find the per cent of increase each year over the preceding year.

## PROBLEMS WITHOUT NUMBERS

1. A man has his bank book balanced March 1 and keeps a record of his checks and deposits during the month. How can he tell his balance on April 1?

2. If you know the date of a promissory note and the time it runs, how can you tell the date of maturity?

3. Besides the facts in Ex. 2 you know the date of discount of a note. How can you find the term of discount?

4. Besides the facts in Ex. 3 you know the face of a note. How can you find the bank discount? the proceeds of the note?

5. Name several methods of sending money by mail.

6. Explain the difference between a bank draft and a commercial draft.

7. What is a traveler's check? a letter of credit?

8. Express by a formula the fact that the percentage equals the product of the base by the rate.

9. Express by a formula the fact that the interest equals the product of the principal, the rate, and the time.

10. Let  $b$  represent the base of a rectangle and  $h$  the altitude. Express the area by a formula.

11. If you buy an article for  $x$  dollars and sell it for  $y$  dollars, how can you express your gain in dollars?

12. If a number is added to (or subtracted from) one member of an equation, what must be done to the other member to keep the equation true?

13. If one member of an equation is multiplied by (or divided by) a given number, what must be done to the other member to keep the equation true?

## TESTS FOR ACCURACY AND SPEED

NOTE. In such exercises the pupils may occasionally "run number races," to see how many correct answers each pupil can get in a given time. Establish a class standard and let each pupil drill until he has reached it.

Read, add, and test the following :

1. 6,234,510	2. \$52,416.31	3. 3900.0055
4,510,009	43,148.50	2540.0279
325,998	38,547.98	1320.5043
62,740	89,329.89	2684.0005
8,200,050	76,877.66	5074.6503
<u>6,523,741</u>	<u>97,018.32</u>	<u>7083.2004</u>

4. $463\frac{3}{8}$	5. $525\frac{3}{8}$	6. $315\frac{3}{10}$
$229\frac{3}{16}$	$418\frac{5}{8}$	$409\frac{2}{5}$
<u>$451\frac{1}{4}$</u>	<u>$321\frac{1}{8}$</u>	<u>$656\frac{4}{15}$</u>

Subtract and test:

7. 627,000	9. 8000.005	11. 53,980.005
<u>419,898</u>	<u>4123.469</u>	<u>49,996.789</u>
8. $7457\frac{3}{8}$	10. $8300\frac{1}{8}$	12. $4567\frac{1}{20}$
<u>$6598\frac{3}{4}$</u>	<u>$6567\frac{5}{8}$</u>	<u>$2789\frac{1}{25}$</u>

Find the products:

13. \$252.75	14. 528.058	15. 769.0034
<u>22.85</u>	<u>96.095</u>	<u>25.087</u>
16. $\frac{5}{16} \times \frac{7}{12}$	18. $\frac{3}{20} \times \frac{2}{25}$	20. $\frac{3}{10} \times \frac{9}{25}$
17. $22\frac{7}{8} \times 12\frac{3}{4}$	19. $18\frac{1}{4} \times 16\frac{3}{8}$	21. $28\frac{5}{12} \times 17\frac{1}{3}$

Find the quotients to thousandths:

22. $44,498 \div 46$	25. $\$23,164.47 \div 249$	28. $29.4117 \div 6.205$
23. $36,757 \div 49$	26. $\$49,834.56 \div 368$	29. $36.0219 \div 5.01$
24. $\frac{8}{9} \div \frac{3}{16}$	27. $\frac{7}{8} \div \frac{7}{12}$	30. $5\frac{1}{2} \div 3\frac{2}{3}$

Find:

- |                                |                 |                                |
|--------------------------------|-----------------|--------------------------------|
| 31. $37\frac{1}{2}\%$ of 880   | 33. 48% of 2000 | 35. $1.83\frac{1}{3}\%$ of 600 |
| 32. $33\frac{1}{3}\%$ of \$960 | 34. 66% of 3480 | 36. $2.87\frac{1}{2}\%$ of 240 |

Find what per cent the first number is of the second:

- |               |                   |                 |
|---------------|-------------------|-----------------|
| 37. 15 of 300 | 39. \$44 of \$176 | 41. 250 of 40   |
| 38. 16 of 480 | 40. \$92 of \$276 | 42. 3400 of 170 |

Find the profit or loss:

COST	RATE OF GAIN	COST	RATE OF LOSS
43. \$400.75	24%	45. \$2340	$33\frac{1}{3}\%$
44. \$895.50	30%	46. \$4860	18%

Find the discount and the net price:

LIST PRICE	RATE OF DISCOUNT	LIST PRICE	RATES OF DISCOUNT
47. \$5.25	20%	49. \$2650	5%, 10%
48. \$10.96	25%	50. \$3600	25%, 5%

Find the commission:

SALES	RATE OF COMMISSION	SALES	RATE OF COMMISSION
51. \$550.75	20%	53. \$3600	$16\frac{2}{3}\%$
52. \$480.80	10%	54. \$2400	$37\frac{1}{2}\%$

Find the amount of taxes on the following property:

ASSESSMENT	TAX RATE	ASSESSMENT	TAX RATE
55. \$2500	\$.018	57. \$26,900	$2\frac{1}{10}$ mills
56. \$3700	\$.029	58. \$43,500	$3\frac{1}{2}$ mills

Find the tax rate:

ASSESSED VALUE	TOTAL TAX	ASSESSED VALUE	TOTAL TAX
59. \$2,500,000	\$2500	61. \$7,200,000	\$5400
60. \$3,600,000	\$7200	62. \$6,250,000	\$1875

Find the duty:

VALUE	AD VAL. DUTY	QUANTITY	SPECIFIC DUTY
63. \$16,800	$33\frac{1}{3}\%$	64. 2500 lb.	\$.25 a pound

Find the interest and the amount:

	PRIN.	RATE	TIME		PRIN.	RATE	TIME
65.	\$2650	5%	1½ yr.	67.	\$12,500	6%	1 yr. 2 mo.
66.	\$4095	4½%	2 yr.	68.	\$16,244	4%	3 yr. 1 mo.

Find the annual premium:

	FACE (Fire Insur.)	RATE per \$100		FACE (Life Insur.)	RATE per \$1000
69.	\$15,000	\$.40	71.	\$20,000	\$29.50
70.	\$25,900	\$.55	72.	\$50,000	\$34.80

Find the date of maturity, the term of discount, the bank discount, and the proceeds of the following notes:

	FACE	TIME	DATE OF NOTE	DATE OF DISCOUNT	RATE OF DISCOUNT
73.	\$3600	3 mo.	Mar. 1	April 2	6%
74.	\$5400	2 mo.	April 4	May 5	5%
75.	\$8900	6 mo.	May 1	June 4	6%
76.	\$7200	2 mo.	June 6	July 7	5%
77.	\$3000	60 da.	July 8	Aug. 7	6%
78.	\$2420	90 da.	Oct. 10	Nov. 9	6%

Find the total cost of the following, including the fee:

POSTAL MONEY ORDER		EXPRESS MONEY ORDER	
79. \$2.50	81. \$.65	83. \$5.25	85. \$30
80. \$45	82. \$50.75	84. \$22.75	86. \$90

TELEGRAPHIC MONEY ORDER

87. \$15 (15 words \$1)  
 88. \$55 (15 words \$1.25)

Solve the following equations:

- |                         |                             |
|-------------------------|-----------------------------|
| 89. $x + 2x + 3x = 36$  | 93. $x - 40 = 18$           |
| 90. $12x - 4x + x = 45$ | 94. $5x - 6 = 44$           |
| 91. $x + 35 = 55$       | 95. $3x - 10 = 12 + 2x$     |
| 92. $\frac{3x}{5} = 21$ | 96. $\frac{5x}{8} + 9 = 34$ |





## CHAPTER VI

### STOCKS AND BONDS

#### STOCKS

The children in the Fulton School wished to start a school garden on some land which was lent to them without charge. They found that they had to raise \$200 for garden tools, seeds, and fertilizers. Some of them, however, could not contribute as much as others. They therefore formed a company called "The Fulton School Garden Company." They divided the \$200, which they called their **capital**, into 100 parts and issued **shares of stock** at \$2 each. The **par value** of each share was \$2. Each child could buy as many shares as he wished.

1. How much did David pay for 10 shares of the stock?
2. How much did Martha pay for 5 shares of the stock?
3. When Martha moved out of town, she wished to sell her shares in a hurry. She sold the 5 shares to John **below par** at \$1.50 a share. How much did John pay for them? At what per cent **below par** were they sold?

SUGGESTION.  $\$2 - \$1.50 = \$.50, \frac{50}{200} = ?\%$

4. After the company began to make a profit, Louis wished to buy 5 shares but no one was anxious to sell. So he had to pay \$3 a share. What per cent was this **above par**? How much did Louis pay for 5 shares?

5. At the end of the season, when all the vegetables were sold, the company had made a net profit of \$100. \$80 was set aside to increase the capital. What per cent of the capital of \$200 was the remaining \$20?

The company agreed to pay each stockholder 10% of the par value of his stock, or a **dividend** of 10%. How much did they pay to each of the following:

6. David owned 10 shares. How much dividend did he receive?

SOLUTION.  $10 \times \$2 = \$20$ ; 10% of \$20 = \$2.

7. Ethel owned 12 shares. How much dividend did she receive?

8. Louis owned 5 shares. How much dividend did he receive?

In many cases, especially in an enterprise requiring large amounts of money, a business is conducted by a company of persons known as a **corporation** or a **stock company**. A corporation is authorized by law to transact business as an individual. Its rights and duties are stated in its **charter**.

The money contributed to carry on the business is known as the **capital**, **capital stock**, or **stock** of the company.

The stock is divided into equal parts called **shares**. To every holder of stock is given a **stock certificate**, a written statement of the number of shares to which the person receiving the certificate is entitled and of the value of each share.

The amount specified on the face of the stock certificate is called the **par value**.

The par value of the shares in different corporations varies from \$1 to \$100, though it is generally \$100. The persons who form the corporation determine the number of shares into which the capital stock shall be divided and the par value of the shares. Observe that the certificate on p. 231 gives the number and the par value of the shares.

## STOCK CERTIFICATE

*Incorporated under the Laws of the State of Vermont**No. 25**20 Shares***Independent Marble Company**

*This certifies that James Wood is the owner of Twenty full-paid shares of the Capital Stock of One Hundred Dollars each of the Independent Marble Company.*

*Transferable only on the books of the Company by the holder, in person, or by an attorney upon the surrender of this certificate.*

*John L. Storer, President*

*George A. Gray, Secretary*

*Montpelier, Vermont, July 1, 1919*

A person who holds stock in a corporation is called a **stockholder**.

9. A company was organized for business with a capital of \$300,000. How many shares of a par value of \$100 were there?

10. A mining company had a capital stock of \$75,000. How many shares of stock did it have, if the par value of a share was \$25?

The body of men who manage the affairs of a corporation is the **board of directors**. They are elected by the stockholders.

The part of the net profits divided among the stockholders, in proportion to the par value of their stock, is called a **dividend**. Dividends are paid yearly, half-yearly, or quarterly, as the board of directors may determine.

The dividend is a per cent of the par value of the stock.

If a 4 % dividend is declared on a capital stock of \$100,000, 4 % of \$100,000, or \$4000, is divided among the stockholders in proportion to the number of shares owned.

The stock of a company may be **preferred stock** or **common stock**. Before any dividend can be paid on the common stock, the dividend on the preferred stock, usually at a fixed rate of from 5 % to 7 %, must be paid. The dividend left after the preferred dividend has been paid is divided among the common stockholders.

Shares of stock are usually bought and sold through a **stock broker** whose business is the buying and selling of stocks. The charge made by brokers is known as **brokerage**.

On the New York Stock Exchange the brokerage is \$.07½ a share on stock selling below \$10 per share; \$.15 a share on stock selling between \$10 and \$125 per share; and \$.20 a share on stock selling over \$125 per share. The minimum charge, however, is \$1.

In addition, stamp taxes are imposed by the national government and by some states. These will not be considered in this book.

The rapid fluctuations in value of some stocks often render them a dangerous form of investment.

The price at which a stock sells at a given time is called its **market value**. The market values of the principal stocks are given in the daily papers. The following list shows how stocks are quoted in the newspapers:

American Produce	34½	Eastern R. R.	118½
American Silk	229½	General Locomotive	48
American Silk pf.	113½	General Locomotive pf.	104½
American Tin	233	General Mining	3½
Central Motor Company	325	Int. Rubber	100½
Central R. R.	30½	Ohio Central	121
Central R. R. pf.	47½	Universal Zinc	39½

The above quotations mean that American Produce is selling at \$34½ a share, American Silk at \$229½ a share, etc.

The market value of a stock depends on the demand for it. The demand is great or small as the dividends paid make it a good or a poor investment. A stock with high dividends will sell for more than the par value, while a stock with low dividends will sell for less than the par value.

The preferred stocks are marked pf. In every case in the above list, except American Silk, the preferred stock exceeds in value the corresponding common stock. The fact that the dividend on a preferred stock must be taken from the profits before a dividend can be paid on the common stock makes the preferred stock generally a safer investment. In the case of American Silk, after the dividend on the preferred stock had been paid, the remaining profit was still so great as to pay a much larger dividend on the common stock than was paid on the preferred stock. The market value of this common stock is therefore much higher than that of the corresponding preferred stock.

Stocks selling for more than their par value are said to be **above par**. Stocks selling for less than their par value are said to be **below par**.

**NOTE.** The newspaper quotations do not show what the par value is. If a stock quoted at 48 has a par value of \$50 it is  $\frac{2}{5}$ , or 4 %, below par; but if a stock quoted at 48 has a par value of 100, it is 52 % below par.

*In the following problems a par value of \$100 is to be assumed, unless otherwise stated.*

### Written Work

Find the cost of the following stocks, par value \$100, including brokerage at \$.15 a share.

1. 50 shares of Int. Rubber at  $100\frac{1}{8}$ .

**SOLUTION.**  $\$100.125 + \$.15 = \$100.275$ , complete cost of 1 share;  
 $50 \times \$100.275 = \$5013.75$ , cost of 50 shares.

2. 560 shares of Central R. R. pf. at  $47\frac{3}{4}$ .
3. 120 shares of General Mining at  $13\frac{1}{2}$ .
4. 90 shares of Eastern R. R. at  $118\frac{7}{8}$ .
5. 150 shares of South American Coffee at  $78\frac{1}{8}$ .

Find the cost of the following, par value \$50, including brokerage at \$.15 a share.

6. 100 shares of Universal Tool at 65.

SOLUTION.  $\$65 + \$.15 = \$65.15$ , complete cost of 1 share;  
 $100 \times \$65.15 = \$6515$ , cost of 100 shares.

7. 10 shares of American Tin at 45.

8. 200 shares of Farm Tractors at 75.

Find the proceeds from the sale of the following, par value \$100, brokerage \$.15.

9. 100 shares Western Lumber at  $98\frac{5}{8}$ .

SOLUTION.  $\$98.625 - \$.15 = \$98.475$ , proceeds from 1 share;  
 $100 \times \$98.475 = \$9847.50$ , proceeds from 100 shares.

10. 50 shares of Midland R. R. at  $89\frac{1}{8}$ .

11. 10 shares of Warner Milling at  $93\frac{5}{8}$ .

12. 100 shares of United States Chemical at  $105\frac{1}{4}$ .

**Dividends and Incomes.**

### Oral Work

1. What is the income from \$100 for 1 year at 6%?
2. What is the income from \$100 invested at par in a share of stock in a manufacturing plant that pays a dividend of 8%?

3. Why is a \$100 share of preferred stock, which pays a dividend of \$7 each year, worth more than \$100?

4. Why is a \$100 share of stock that pays a dividend of only \$2 worth less than \$100?

5. Find the dividend on 10 shares of stock, par value \$100, at 5%.

SOLUTION.  $10 \times \$100 = \$1000$ ; 5% of \$1000 = \$50, dividend.

6. Find the dividend on 10 shares of stock, par value \$50, at 5%.

SOLUTION.  $10 \times \$50 = \$500$ ; 5% of \$500 = \$25, dividend.

## Written Work

NOTE. The par value in the following examples is \$100 except in Ex. 5.

1. What is my income from 25 shares of stock paying 7% annual dividends?

2. I own 112 shares of stock paying a quarterly dividend of  $1\frac{3}{4}\%$ . What is my annual income from this stock?

3. 100 shares of stock are bought for \$10,300. If a dividend of 5% is declared, how much does the owner of the stock receive?

4. A dividend of 4% is declared by a company capitalized at \$700,000. How much does the owner of 45 shares of stock receive?

5. The Int. Electric pays a dividend of 5%. Find the annual income from 100 shares of this stock, par value \$50.

NOTE. In Ex. 6-10, add \$.15 a share for brokerage to the cost and subtract \$.15 a share from the amount received from the sale.

6. Find the gain when 80 shares of Central Fuel Supply, which cost  $109\frac{1}{8}$ , are sold at  $116\frac{3}{4}$ .

7. 100 shares of Southern Sugar are bought at  $100\frac{1}{4}$  and sold at  $97\frac{1}{2}$ . What is the loss?

8. 56 shares of Western Electric are bought at  $123\frac{3}{8}$  and sold at  $128\frac{1}{4}$ . What is the gain?

9. How much is gained by buying 470 shares of stock at 96 and selling at 98?

10. 100 shares of Western Canning are bought at  $71\frac{1}{4}$  and 50 shares at  $70\frac{1}{2}$ . All are sold at 65. How much is lost?

11. A man owning 100 shares of National Copper, worth 237 and paying a dividend of 12%, sells it (brokerage \$.20 a share), and buys with the proceeds a house, which nets him 6% in rent. Does he gain or lose in income and how much?

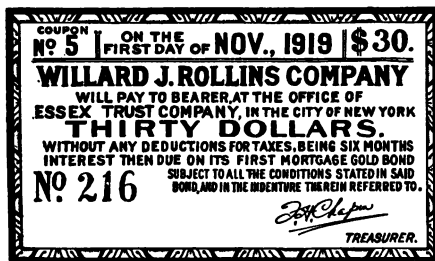
## BONDS

When a corporation needs more money to carry on its business, it may borrow it by issuing a series of bonds payable at some future date, with interest.

A **bond** is a written or a printed agreement, under seal, by which the maker binds himself to pay a specified sum at a fixed rate of interest, in a definite time.

Bonds are often secured by mortgages on property. Such mortgages authorize the sale of the property in case the conditions of the bonds are not fulfilled.

The terms **par value** and **market value** mean the same



COUPON

when applied to bonds as when applied to stocks.

A bond with interest coupons attached is called a **coupon bond**. The coupons are detached when the interest is due, and the amount may be collected

personally or through a bank. Coupon bonds are payable to the bearer.

A bond registered on the books of the corporation issuing it is called a **registered bond**. The interest on registered bonds is sent by check to the owner. Registered bonds are payable to the owner or to his assignee.

The name of a bond often indicates the government, the municipality, or the corporation by which it is issued, *its rate of interest*, and the time when the bond is *due*. Thus, "U. S. 4's, 1925," are United States 4% bonds, due in 1925; "Western Chemical 5's, 1930," are Western Chemical bonds, due in 1930, and bearing 5% interest; "U. S. Copper 6's" are United States Copper bonds, bearing 6% interest.



The market values of bonds are reported in the newspapers. The following are illustrations of such quotations:

U. S. 4's reg. 1930	100½
U. S. 4's coupon 1925	108½
U. S. Liberty 4th, 4½'s 1933-1938	99
American Railway 4½'s	96½
Western Chemical 6's 1930	117
Western Copper 4½'s	88

A Western Chemical bond, par value \$1000, was worth, when the above quotation was made, 117% of \$1000, or \$1170. A Western Copper 4½% bond, par value \$1000, was worth 88% of \$1000, or \$880. A U. S. Liberty 4th 4½% bond, par value \$50, was worth 99% of \$50, or \$49.50. A U. S. Liberty 4th 4½% bond, par value \$100, was worth \$99, etc.

Bonds do not fluctuate in value as much as do stocks and are *safer for investment*.

**Stockholders** are the *owners* of shares of stock representing their interest in the corporate property; **bondholders** are *creditors* who have loaned money to the corporation or the government. Bonds bear *interest* at a fixed rate and mature at a time specified in the bond; **stocks** continue while the corporation exists and pay dividends according to the earnings of the company.

The brokerage on bonds is usually ½% of the **par value**, that is, \$1.25 per \$1000 of par value.

### Written Work

Find the cost of:

1. 15 Star Coffee 4's, par value \$1000, at 101½, brokerage ½%.

SOLUTION.  $101\frac{1}{2}\% + \frac{1}{2}\% = 102\%$ ;  $102\%$  of \$15,000 = \$15,300.

2. 3 Industrial 5's, par value \$1000, at 87, brokerage ½%.

3. 20 Pacific Gold 4's par value \$1000, at 90½, brokerage ½%.

4. 10 Gem Soap 5's, par value \$1000, at 61½, brokerage ½%.

5. 5 Liberty Loan 1st 3½'s, par value \$100, at par (total brokerage \$1).

6. 10 Liberty Loan 4th 4½'s par value \$50, at par (total brokerage \$1).

Find the proceeds from the sale of the following bonds, par value \$1000, brokerage  $\frac{1}{8}\%$ .

7. \$10,000 American Railway at  $96\frac{1}{8}$ .

SOLUTION.  $96\frac{1}{8}\% - \frac{1}{8}\% = 96\%$ ;  $96\%$  of \$10,000 = \$9600, proceeds.

8. \$16,000 American Tin 4's, coupon, 1925, at  $108\frac{3}{8}$ .

9. \$21,000 Southern Sugar  $4\frac{1}{2}$ 's at  $103\frac{5}{8}$ .

10. \$7000 Standard Rubber 4's reg. 1930, at  $100\frac{5}{8}$ .

11. \$5000 Maine Ice Sec.  $3\frac{1}{2}$ 's are bought for  $84\frac{3}{8}$  and sold for  $83\frac{1}{8}$ , brokerage  $\frac{1}{8}\%$ . What is the loss?

12. A house worth \$10,000 is traded for \$8000 Western Thread Company 4's at 91 and a cash payment. How much is the cash payment (no brokerage)?

13. What is the difference in value between \$10,000 Wolcott Mine at 55 and \$6000 Int. Lead at  $93\frac{1}{4}$  (no brokerage)?

Find the annual interest on the following \$1000 bonds:

14. \$4000 U. S. 4's reg., 1925.

SOLUTION.  $4\%$  of \$4000 = \$160.

15. \$10,000 General Industrial 5's.

16. \$6000 U. S. 3's, coupon, 1918.

17. \$15,000 U. S. Chemical 4's.

18. \$20,000 American Produce  $4\frac{1}{2}$ 's.

19. \$10,000 U. S. 2's, reg.

Find the semiannual interest due on the following Liberty bonds:

20. \$1000, 1st,  $3\frac{1}{2}$ 's    22. \$50, 2d, 4's    24. \$400, 3d,  $4\frac{1}{4}$ 's

21. \$300, 2d, 4's    23. \$200, 4th,  $4\frac{1}{4}$ 's    25. \$2000, 4th,  $4\frac{1}{4}$ 's

26. Mrs. Burt has a \$1000 Liberty Loan bond of the fourth issue, bearing interest at  $4\frac{1}{4}\%$ , payable semiannually on April 15 and Oct. 15. What amount of semiannual interest is due on this bond on Oct. 15, 1919?

## MEASUREMENT OF GEOMETRIC FORMS

### TRIANGLES

A surface such that a straight line joining any two points of it lies wholly in the surface is called a **plane surface**.

A surface bounded by three straight lines is called a **triangle**. The side on which it is supposed to stand is called its **base**. The point where two sides meet is called the **vertex**.

The perpendicular distance from the vertex opposite the base to the base, or the base extended, is called the **altitude**.

Triangles are named from their angles as follows :

- (1) **Right-angled** (or **right**) triangles. (One right angle.)
- (2) **Acute-angled** (or **acute**) triangles. (All angles less than a right angle.)
- (3) **Obtuse-angled** (or **obtuse**) triangles. (One angle greater than a right angle.)



**RIGHT-ANGLED**



**ACUTE-ANGLED**



**OBTUSE-ANGLED**

Draw a right triangle; an acute-angled triangle; an obtuse-angled triangle.

Triangles are named from their sides as follows :

- (1) **Equilateral**. (Having three sides equal.)
- (2) **Isosceles**. (Having two sides equal.)
- (3) **Scalene**. (Having no two sides equal.)



**EQUILATERAL**

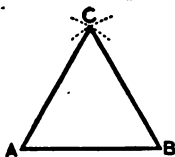


**ISOSCELES**



**SCALED**

To draw an equilateral triangle, draw the base line  $AB$ . Place the pin of your compasses on  $A$  and the pencil on  $B$ , and draw an arc. Then place the pin on  $B$  and the pencil on  $A$  and draw another arc. Connect the point of intersection,  $C$ , with  $A$  and  $B$ , as shown in the diagram.  $ABC$  is an equilateral triangle.



1. Draw with your compasses an equilateral triangle, 1 in. on each side; an isosceles triangle, with the equal sides each 1 in. long; a scalene triangle, with one side 1 in. and another  $1\frac{1}{2}$  in. long.

2. Measure all the angles of a triangle with a protractor and find their sum. Repeat this process with other triangles.

*The sum of all the angles of any triangle is equal to two right angles, or  $180^\circ$ .*

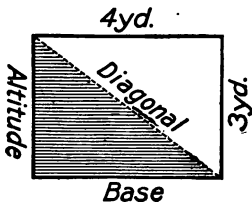
### Written Work

The following numbers in each case represent the size of two angles of a triangle. Find the size of the third angle:

- |                              |                                                     |                                   |
|------------------------------|-----------------------------------------------------|-----------------------------------|
| 1. $90^\circ$ and $45^\circ$ | 3. $120\frac{1}{2}^\circ$ and $40\frac{1}{2}^\circ$ | 5. $100^\circ 45'$ and $37^\circ$ |
| 2. $90^\circ$ and $60^\circ$ | 4. $60^\circ$ and $40^\circ$                        | 6. $100^\circ$ and $45^\circ 40'$ |

**How to find the area of a right triangle.**

1. Find the area of a right triangle whose base is 4 yd. and whose altitude is 3 yd.



Observe: 1. That the diagonal divides the rectangle into two equal right triangles.

2. That the unit of measure is 1 sq. yd.

3. That the area of one of the right triangles is  $\frac{1}{2}$  of the area of the rectangle; that is,  $\frac{1}{2}$  of  $4 \times 3$  sq. yd., or 6 sq. yd.

*The area of a right triangle is found by multiplying the unit of measure by one half the product of the base and the altitude.*

If  $A$  represents the area;  $b$ , the base, and  $h$ , the height or altitude, we have the following formula:

FORMULA: 
$$A = \frac{b \times h}{2}.$$

Find the area of each of the following right triangles:

2. Base 10 in., altitude 6 in.
5. Base 10 ft., altitude 7 ft.
3. Base 12 yd., altitude 8 yd.
6. Base 14 ft., altitude 10 ft.
4. Base 9 ft., altitude 6 ft.
7. Base 6 ft., altitude 20 ft.

**How to find the area of any triangle.**

### Written Work

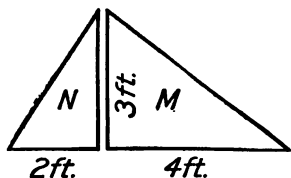
1. Find the area of two right triangles, the base of one being 2 ft. and of the other 4 ft. and the altitude of each 3 ft.

Draw the triangles as shown in the figure.

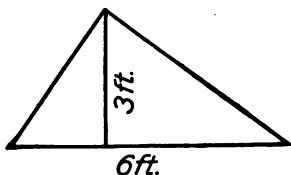
Observe: 1. That the *unit* of measure is 1 sq. ft.

2. That the area of the right triangle  $N$  is equal to  $\frac{1}{2}$  of  $2 \times 3$  sq. ft., or 3 sq. ft.

3. That the area of the right triangle  $M$  is equal to  $\frac{1}{2}$  of  $4 \times 3$  sq. ft., or 6 sq. ft. Therefore the area of  $N$  plus the area of  $M$  is equal to  $\frac{1}{2}$  of  $6 \times 3$  sq. ft., or 9 sq. ft.



2. Find the area of a triangle whose base is 6 ft. and whose altitude is 3 ft.



Observe that the area of the triangle in example 2 equals the area of the two right triangles in example 1; therefore it equals  $\frac{1}{2}$  of  $6 \times 3$  sq. ft., or 9 sq. ft.

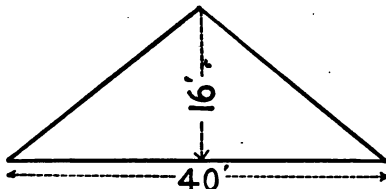
*The area of any triangle is found by multiplying the unit of measure by one half the product of the base and the altitude.*

FORMULA:

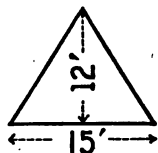
$$A = \frac{b \times h}{2}$$

Find the area of the following triangles:

3. Base 20 ft., alt. 14 ft.
5. Base 15 ft., alt. 8 ft.
4. Base 30 ft., alt. 12 ft.
6. Base 28 ft., alt. 14 ft.
7. Find the areas of the following gables:

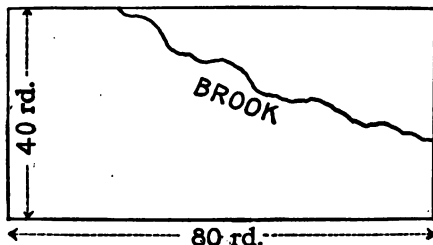


GABLE OF A BARN OR A HOUSE



GABLE OF A TENT

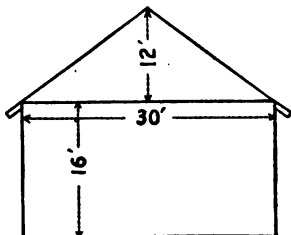
8. Mr. Smith's farm is in the form of a rectangle and has a running stream across one corner. If the corner cut



off by the stream is 58 rd. long and 24 rd. wide, find the approximate area of each part.

cloth in a sleeping-room tent, the sides of which are  $15' \times 10'$  and the triangular ends  $12'$  long and  $8'$  high; in a cooking tent with sides  $22' \times 15'$  and triangular ends  $18' \times 12'$ .

10. Find the area of the gable; then the area of the gable end of this house.

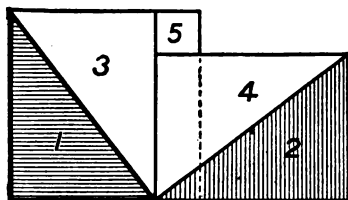
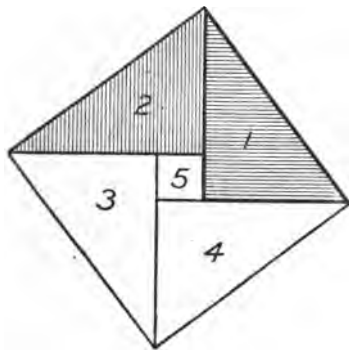
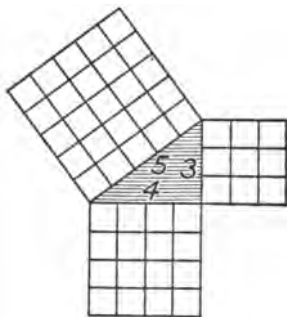


### How to find the hypotenuse of a right triangle.

The side of a right triangle opposite the right angle is called the **hypotenuse**.

1. How many square units are there in the square described upon the hypotenuse? in the square described upon the perpendicular? in the square described upon the base?

2. How do the number of square units upon the hypotenuse compare with the *sum* of the square units upon the other two sides?



Draw the square on the hypotenuse of right triangle 1. Cut this square into the four equal triangles 1, 2, 3, and 4, and the small square 5. By changing the position of triangles 1 and 2, as indicated, you change the *first* diagram into the *second*. The *first* is the square on the hypotenuse, and the *second* is the sum of the squares on the other two sides.

*The square on the hypotenuse of a right triangle equals the sum of the squares described on the other two sides.*

If  $H$  = the hypotenuse, and  $a$  and  $b$  the other sides:

FORMULA:  $H^2 = a^2 + b^2$ .

One of *two equal factors* of a number is called its **square root**.

Thus, the square root of  $25 = 5$ , written  $\sqrt{25} = 5$ .

#### SQUARES OF NUMBERS 13 TO 25

Square of 13 = 169

Square of 19 = 361

Square of 14 = 196

Square of 20 = 400

Square of 15 = 225

Square of 21 = 441

Square of 16 = 256

Square of 22 = 484

Square of 17 = 289

Square of 23 = 529

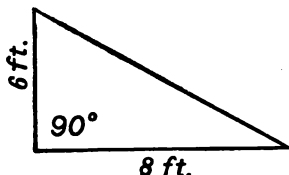
Square of 18 = 324

Square of 24 = 576

Square of 25 = 625

NOTE. For table of squares and square roots, see p. 318.

#### Written Work



1. Find the hypotenuse of this right triangle.

$$6^2 + 8^2 = 100, \text{ hypotenuse}^2$$

$$\sqrt{100} = 10, \text{ no. of ft., in hypotenuse}$$

Draw figures to a convenient scale and find the unknown side:

	BASE	PERPENDICULAR	HYPOTENUSE
2.	3 in.	4 in.	?
3.	?	3 ft.	5 ft.
4.	5 ft.	12 ft.	?
5.	15 yd.	20 yd.	?

6. Find the length of the longest straight line that can be drawn on a table 12 ft. by 9 ft.

7. A has a field 30 rd. wide and 40 rd. long. B has a square field whose side equals the diagonal of A's field. What is the difference in the areas of the two fields?



# QUADRILATERALS

A plane surface bounded by four straight sides is called a **quadrilateral**. (Quadrilateral means *having four sides*.)

1. A quadrilateral whose opposite sides are parallel is called a **parallelogram**.

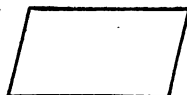
2. A quadrilateral having four straight sides and four right angles is called a **rectangle**.

3. A quadrilateral having four equal sides and four right angles is called a **square**.

4. A quadrilateral whose four sides are *equal* and whose angles are *not* right angles is called a **rhombus**.



RHOMBUS



RHOMBOID

5. A quadrilateral whose *opposite* sides are equal and whose angles are *not* right angles is called a **rhomboid**.



TRAPEZOID



TRAPEZIUM

6. A quadrilateral having but *two* sides parallel is called a **trapezoid**.

7. A quadrilateral having no two sides parallel is called a **trapezium**.

8. Draw each of the six quadrilaterals described above and write its name beneath it. How many of these quadrilaterals are parallelograms? Give reasons.

## AREAS OF RECTANGLES

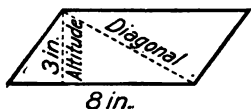
*The area of a rectangle is found by multiplying the unit of measure by the product of its two dimensions.*

## Written Work

Find the areas of rectangles having the following dimensions:

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| 1. 6.5 ft. by 41 ft.              | 5. 9 ft. by 57.5 ft.             |
| 2. 5.25 ft. by 27.6 ft.           | 6. 14 ft. by $22\frac{1}{2}$ yd. |
| 3. $20\frac{1}{4}$ yd. by 144 yd. | 7. 54 in. by 6 ft.               |
| 4. 4.5 yd. by 7.5 yd.             | 8. 54.5 ft. by 108 ft.           |

Find the area of a parallelogram whose base is 8 in. and altitude 3 in.



Observe: 1. That the diagonal of the parallelogram divides it into two equal triangles.

2. That the area of each triangle is equal to  $\frac{1}{2}$  of  $8 \times 3$  sq. in., and the area of the parallelogram is equal to  $\frac{2}{2}$ , or once, the product of the base and the altitude; that is,  $8 \times 3$  sq. in., or 24 sq. in.

*The area of a parallelogram is found by multiplying the unit of measure by the product of the base and the altitude.*

FORMULA :

$$A = b \times h.$$

## Written Work

Find the area in acres of :

1. A parallelogram whose base is 140 rd. and altitude 60 rd.
2. A rhomboid whose base is 90 rd. and altitude  $50\frac{1}{2}$  rd.
3. A rhombus whose base is 120 rd. and altitude 100 rd.

Find the altitude of :

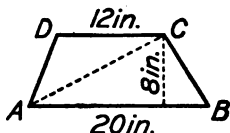
4. A rhomboid whose area is 384 sq. ft. and base 48 ft.
5. A rhomboid whose area is 576 sq. in. and base 64 in.
6. Find the base of a parallelogram whose altitude is 60.5 rd. and whose area is 30.25 A.

# How to find the area of a trapezoid and a trapezium.

## Written Work

1. Find the area of a trapezoid whose parallel sides are 20 in. and 12 in., and whose altitude is 8 in.

Examine the trapezoid  $ABCD$ . Draw the diagonal  $AC$ , dividing it into two triangles.



Observe: 1. That the area of the trapezoid is equal to the area of its two triangles  $ABC$  and  $ACD$ .

2. That the area of the triangle  $ABC$  equals  $\frac{1}{2}$  of  $20 \times 8$  sq. in.
3. That the area of the triangle  $ACD$  equals  $\frac{1}{2}$  of  $12 \times 8$  sq. in.
4. That the area of the trapezoid equals  $\frac{1}{2}$  of  $(20 + 12) \times 8$  sq. in., or 128 square inches.

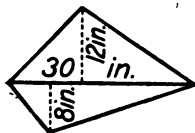
*The area of a trapezoid is found by multiplying the unit of measure by the product of the altitude and one half the sum of the parallel sides.*

FORMULA: 
$$A = \frac{(a + b) \times h}{2}$$

2. The parallel sides of a trapezoid are 38 in. and 62 in., and its altitude is 21 in. Find its area.

3. The area of a trapezoid is 2.5 A. The sum of its parallel sides is 80 rd. Find its altitude.

4. Find the area of a trapezium whose diagonal is 30 in. and whose altitudes are 12 in. and 8 in.



Observe: 1. That the area of the trapezium equals the area of two triangles.

2. That the area of one triangle equals  $\frac{1}{2}$  of  $30 \times 8$  sq. in.

3. That the area of the other triangle equals  $\frac{1}{2}$  of  $30 \times 12$  sq. in.

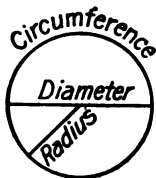
4. That the area of the trapezium equals  $\frac{1}{2}$  of  $30 \times 20$  sq. in., or 300 sq. in.

*The area of a trapezium is found by dividing it into triangles and finding the sum of their areas.*

5. The base line dividing a trapezium into two triangles is 40 ft. The altitude of one triangle is 10 ft. and of the other triangle, 12 ft. Find the area of the trapezium.

6. A trapezium is divided into two triangles by a line 28 ft. long. Find the area of the trapezium, if the altitude of one triangle is 8 ft. and of the other triangle, 14 ft.

## CIRCLES



Observe the figure. What is its shape? Observe that its boundary line changes its direction at every point.

A plane figure bounded by a curved line, every point of which is equally distant from the *center*, is called a **circle**.

The bounding line of a circle is called the **circumference**.

A straight line passing through the center, with both ends terminating in the circumference, is called a **diameter**.

A straight line extending from the center to the circumference is called a **radius**.

**NOTE.** The length of a radius equals one half the length of a diameter.

Any part of a circumference is called an **arc**.

The part of a circle inclosed by two radii and an arc is called a **sector**.

In the following formulas  $C$  represents circumference;  $r$ , radius;  $d$ , diameter;  $\pi$  ( $\pi$ ), 3.1416; and  $A$ , area.

*The circumference of a circle is found by multiplying the diameter (or twice the radius) by 3.1416.*

**FORMULA:**  $C = \pi d$ , or  $2\pi r$ .

*The diameter of a circle is found by dividing the circumference by 3.1416.*

**FORMULA:**  $d = C \div \pi$ .

Draw with your compasses a circle 1 in. in diameter; a circle  $1\frac{1}{2}$  in. in diameter.

### Written Work

Find the circumference if the diameter is :

1. 15 ft.
2. 25 ft.
3. 60 ft.
4.  $10\frac{2}{3}$  ft.
5. 12 ft. 6 in.
6. 28 yd.
7. 40 ft. 4 in.
8. 30 in.
9. 8 yd. 2 ft. 4 in.
10. Circumference equals 25.1328 ft. Radius = ?
11. Circumference equals 125.664 yd. Diameter = ?

### How to find the area of a circle.

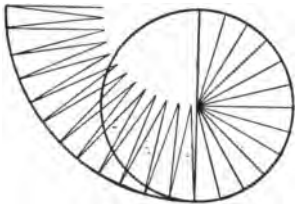
Examine the figure :

Observe: 1. That the circle is made up of sectors, the sum of whose bases form the circumference.

2. That when these sectors are very small each differs but little from its corresponding triangle.

3. That the radius of the circle is very nearly equal to the altitudes of the triangles.

4. That if the sectors are considered triangles whose altitudes are equal to the radius of the circle, then the area of the circle equals the sum of the areas of all the triangles, or  $\frac{1}{2}$  the sum of their bases (circumference) by their altitude (radius). The conclusion is true as shown by geometry.



*The area of a circle is found by multiplying the circumference by one half the radius.*

$$A = \frac{Cr}{2} = \frac{2\pi r \times r}{2} = \pi r^2.$$

*The area of a circle equals  $\pi$  times the square of its radius.*

FORMULA :

$$A = \pi r^2.$$

## Written Work

Circumference =  $C$ ; diameter =  $d$ ; radius =  $r$ ; area =  $A$ .

Find the area if:

- |                 |                 |                 |
|-----------------|-----------------|-----------------|
| 1. $d = 10$ rd. | 4. $r = 18$ ft. | 7. $r = 40$ rd. |
| 2. $r = 10$ rd. | 5. $d = 20$ in. | 8. $d = 25$ yd. |
| 3. $d = 18$ ft. | 6. $r = 20$ in. | 9. $r = 60$ ft. |

Find the area to two decimal places if:

- |                      |                  |                   |
|----------------------|------------------|-------------------|
| 10. $C = 8.1416$ ft. | 13. $d = 35$ yd. | 16. $r = 125$ ft. |
| 11. $C = 6.2832$ rd. | 14. $r = 10$ ft. | 17. $d = 120$ yd. |
| 12. $C = 94.248$ in. | 15. $d = 10$ yd. | 18. $r = 19$ yd.  |

19. A circular fountain 20 ft. in diameter is surrounded by a cement walk 4 ft. wide. How much will the walk cost at \$1.50 a square yard?

NOTE. Find the difference between the areas of the two circles, the first bounded by the circumference of the fountain, and the second, by the circumference of the walk, the diameter of which is 28 ft.

## RECTANGULAR SOLIDS

The space occupied by an object that has length, breadth, and thickness, is called a **solid**.

The surfaces that bound a solid are called its **faces**.

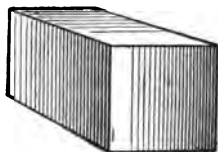
The area of the sides, or faces, of a solid is called its lateral or **convex surface**.

The number of cubic units a solid contains is called its **volume**.

- |                             |                          |
|-----------------------------|--------------------------|
| 1728 cubic inches (cu. in.) | = 1 cubic foot (cu. ft.) |
| 27 cubic feet               | = 1 cubic yard (cu. yd.) |
| 128 cubic feet              | = 1 cord of wood         |
| 1 cubic yard of earth       | = 1 load                 |

A solid bounded by six equal square faces is called a **cube**.

A solid bounded by six rectangular surfaces is called a **rectangular solid**.



### Written Work

Find the entire surface of :

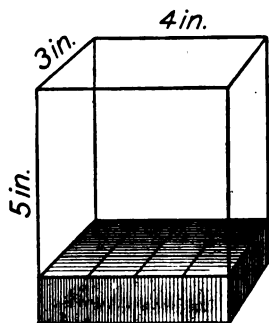
#### RECTANGULAR SOLIDS

1. 12 ft. by 8 ft. by 6 ft.
2. 20 in. by 10 in. by 10 in.
3. 16 ft. by 2 ft. by  $1\frac{1}{2}$  ft.
4. 10 ft. by 8 ft. by 7 ft.
5. 6 ft. by 5 ft. by 5 ft.
6. 13 ft. by 8 ft. by 3 ft.

#### CUBES

7. 4 inches on an edge.
8. 12 inches on an edge.
9. 2 feet on an edge.
10.  $12\frac{1}{2}$  inches on an edge.
11. 14 inches on an edge.
12.  $11\frac{1}{2}$  feet on an edge.

Each cube in the solid represents **1 cubic inch**. How many cubic inches are there in the first layer? How many such layers does this solid contain? How many cubic inches does the solid contain? Observe that the product of the three dimensions expresses the number of *cubic units*.



Scale : 1 in. to  $\frac{1}{4}$  in.

*The volume of a rectangular solid is found by multiplying the unit of measure by the product of its three dimensions when expressed in like units.*

If  $V$  represents the volume ;  $l$ , the length ;  $w$ , the width ; and  $h$ , the height, we have the following formula :

FORMULA :

$$V = l \times w \times h.$$

## Written Work

1. Find the volume of a rectangular solid 8 ft. 6 in. square and 12 ft. 4 in. in length.

SOLUTION.  $8.5 \times 8.5 \times 12\frac{1}{3} \text{ cu. ft.} = 891.08\frac{1}{3} \text{ cu. ft., volume.}$

Find the contents or volume of the following solids :

2. 10 ft. by 6 ft. 3 in. by 4 ft.    5. 1 yd. by 2 ft. by 18 in.  
 3. 12 ft. by 9 ft. 6 in. by 6 ft.    6. 68 in. by 1 ft. by 10 in.  
 4. 10 ft. square and 8 ft. high.    7. 5 yd. by  $1\frac{1}{2}$  yd. by 2 ft.

8. How many loads of earth must be removed in excavating for a cellar 24 ft. by 30 ft. and 8 ft. in depth ?

9. Estimate the number of cakes of soap 3 in. by 2 in. by 2 in. that can be packed in a box 3 ft. by 2 ft. by 2 ft.

10. A schoolroom is 28 ft. by 40 ft. by 16 ft. How many cubic feet of air space are there for each of 39 pupils and their teacher ?

11. How many cords of 4-foot wood are there in a pile 40 ft. long and 4 ft. high ?

12. Estimate the number of cords of 18-inch wood in 3 piles each 60 ft. long and 4 ft. high.

NOTE. The number of cords of short wood in a pile is found by dividing the number of square feet in one side by 32.

13. How many cubical boxes 3 ft. 6 in. on an edge can be placed in a storage room 14 ft. in length, width, and height ?

In a certain township, the piles of 20-inch wood in the yards of four schools were as follows :

	NO. OF PILES	LENGTH OF PILES	HEIGHT OF PILES
14. Sykes,	{ 1	60 ft.	4 ft.
	{ 2	40 ft.	6 ft.
15. Graham,	{ 2	50 ft.	5 ft.
	{ 1	60 ft.	4 ft.
16. Wilson,	{ 1	72 ft.	5 ft.
	{ 2	45 ft.	6 ft.



	NO. OF PILES	LENGTH OF PILES	HEIGHT OF PILES
17. Clark,	$\begin{cases} 2 \\ 1 \end{cases}$	36 ft.	5 ft.
		60 ft.	4 ft.

Estimate the number of cords at each school and the value of the wood at \$1.85 a cord.

18. Find the number of loads of earth removed in excavating for a cellar 16 ft. wide, 30 ft. long, and 6 ft. in depth.

19. A pile of wood is 8 ft. wide, 100 ft. long, and 9 ft. high. Find the number of cords it contains.

20. A cubical block of granite 2 ft. on an edge is what part of a cubical block of granite 6 ft. on an edge?

When possible, use cancellation in the following problems:

21. Cape Cod cranberries are shipped in a crate whose inside dimensions are 20 in.  $\times$   $10\frac{1}{2}$  in.  $\times$   $6\frac{3}{4}$  in. How many cubic inches are there in a crate?

22. Sweet potatoes are sometimes sold in a box  $19\frac{1}{4}$  in.  $\times$   $11\frac{3}{4}$  in.  $\times$  10 in. How much does this differ from a bushel (2150.4 cu. in.)?

23. Colorado apples are sometimes shipped in a box 18 in.  $\times$   $11\frac{1}{2}$  in.  $\times$  11 in. How many cubic inches more or less than a bushel does such a box contain?

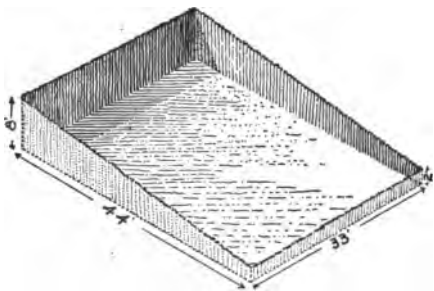
24. Colorado apples are sometimes shipped in a box 16 in.  $\times$   $11\frac{3}{4}$  in.  $\times$   $8\frac{5}{8}$  in. How many cubic inches does such a box contain?

25. California celery is shipped in crates  $24\frac{1}{4}$  in.  $\times$  22 in.  $\times$   $20\frac{1}{2}$  in. How many cubic inches are there in such a crate?

26. California dates are sold in boxes  $17\frac{1}{4}$  in.  $\times$  10 in.  $\times$   $9\frac{1}{4}$  in. How many cubic inches are there in such a box?

27. The standard California orange box is 24 in.  $\times$   $11\frac{1}{2}$  in.  $\times$  12 in. Tangerines are shipped in boxes 24 in.  $\times$  12 in.  $\times$   $6\frac{1}{2}$  in. Which is the larger, and how many cubic inches larger is it?

28. How many cubic inches are there in a box  $5\frac{1}{2}$  in.  $\times$   $8\frac{1}{4}$  in.  $\times$   $2\frac{3}{4}$  in.? Find the number of cubic inches in a box  $8\frac{1}{2}$  in.  $\times$   $12\frac{1}{2}$  in.  $\times$   $4\frac{1}{4}$  in.



29. A man has a cellar to dig  $33' \times 44'$ . The rear end is to be dug 8' deep, and the front end 2' deep. Find

the number of loads to be removed.

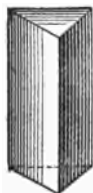
## PRISMS AND CYLINDERS

### Surfaces

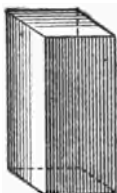
A solid whose sides are parallelograms and whose two ends, or **bases**, are equal polygons, parallel to each other, is called a **prism**.

Prisms are named from the shape of their bases, — *triangular, square, rectangular*, etc.

A rectangular solid is a prism.



TRIANGULAR  
PRISM

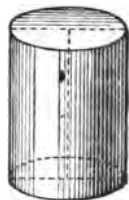


SQUARE  
PRISM

The perpendicular distance between the bases of a prism is called its **altitude**.

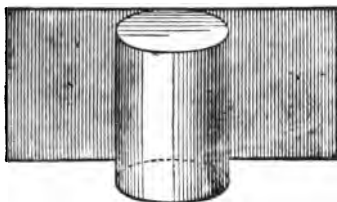
The area of its sides is called its **convex surface**.

A solid bounded by a uniformly curved surface and having for its ends or **bases** circles that are equal and parallel to each other is called a **cylinder**.



NOTE. In this book "cylinder" means "circular cylinder."

The lateral or curved surface of a cylinder is called its **convex surface**. The perpendicular distance between the two bases of a cylinder is called its **altitude**.



Observe: 1. That if a piece of paper is fitted to cover the convex surface of a cylinder and then unrolled, its form is that of a rectangle.

2. That the circumference of the base is the *length* of the rectangle, and the altitude of the cylinder is the *width* of the rectangle.

Cover the convex surface of a prism with a piece of paper and show that when it is unrolled its form is that of a rectangle, the *length* of which equals the perimeter of the solid and the *width*, its altitude.

*The convex surface of a cylinder or of a prism is found by multiplying the unit of measure by the product of the perimeter of the base and the altitude. The entire surface is found by adding the area of the bases to the convex surface.*

### Written Work

Find the convex surface of a cylinder:

- |                            |                           |
|----------------------------|---------------------------|
| 1. $D$ 10 in., alt. 24 in. | 3. $D$ 20 in., alt. 4 ft. |
| 2. $D$ 15 in., alt. 30 in. | 4. $D$ 8 in., alt. 4 ft.  |

Find the convex surface of a regular prism of:

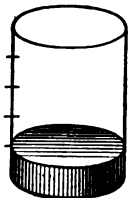
5. 3 sides; each side 20 in., alt. 10 in.
6. 4 sides; bases 14 in. by 12 in., alt. 6 in.
7. Find the entire surface of a water tank that is 12 ft. in diameter and 12 ft. in height.
8. Find the entire surface of a steam boiler that is 15 ft. long and 3 ft. in diameter.

If  $S$  represents the convex surface;  $\pi d$ , the perimeter (or circumference) of the base of a cylinder; and  $P$ , the perimeter of the base of a prism, we have the following formulas:

$$\text{FORMULAS: } S = \pi d \times h. \quad S = P \times h.$$

## Volumes

Find the volume of a cylinder 3 ft. in diameter and 5 ft. high.



Observe: 1. That the area of the base is  $3^2 \times .7854$  sq. ft., or 7.0686 sq. ft.

2. That the first row of cubic units contains 7.0686 cu. ft.

3. That the cylinder contains 5 times 7.0686 cu. ft., or 35.343 cu. ft.

4. Show in a similar manner that a rectangular prism 3 ft. long, 2 ft. wide, and 5 ft. high contains  $3 \times 2 \times 5$  cu. ft., or 30 cu. ft.

*The volume of a cylinder or of a prism is found by multiplying the unit of measure by the area of the base, and this product by the altitude of the cylinder.*

If  $V$  represents the volume;  $\pi r^2$ , the area of the base of a cylinder; and  $B$ , the area of the base of a prism, we have the formulas:

$$\text{FORMULAS: } V = \pi r^2 \times h.$$

$$V = B \times h.$$

## Written Work

Find the volume of a gas tank, a silo, or a cistern:

1.  $D$  15 ft., height 18 ft.
2.  $D$  25 ft., height 30 ft.
3.  $r$  2 ft., depth 8 ft.
4.  $r$  8 ft., height 30 ft.
5. Find the volume of a prism 14 in. sq., alt. 8 in.
6. Find the volume of a hexagonal prism, area of base 225 sq. ft., alt. 22 ft.

NOTE. The capacity of bins is often estimated in bushels. The capacity of tanks and cisterns is estimated in gallons or in barrels. The standard bushel in the United States contains 2150.42 cubic inches, stricken measure, and 2747.71 cubic inches heaped measure.

231 cu. in. = 1 gal.  $31\frac{1}{2}$  gal. = 1 bbl., when estimating contents.

Find to hundredths the number of bushels in:

7. A bin 20' by 10' by 5'.      9. A bin 15' by 12' by 8'.
8. A box 12' by 9' by 6'.      10. A bin 18' by 10' by 6'.
11. A trough for watering cattle is 12 ft. long, 3 ft. wide, and 20 in. deep. Find the number of gallons it holds.
12. The rainfall on a certain day is  $1\frac{1}{4}$  in. Find, to the nearest tenth, the number of barrels of water that fall on Mr. Lane's flower plot, which is 10 ft. wide and 20 ft. long.
13. A house has a roof almost flat, 27 ft. by 42 ft. The rainfall one day is .3 in. If the spouting carries away all the water, how many barrels, to the nearest tenth, fall on the roof?
14. The swimming pool at a school averages 3 ft. and 8 in. of water in a pool 40 ft. by 100 ft. How many gallons of water are there? how many barrels?
15. A man has 40 head of cattle that drink on an average 10 gal. of water each per day. If a windmill averages 10 bbl. an hour, how many hours a day must it run to pump enough water for the cattle?

**Approximate equivalents of the following measures are:**

1 bu. shelled grains	= $1\frac{1}{4}$ cu. ft.
1 bu. apples	= $1\frac{5}{9}$ cu. ft.
1 bbl. in estimating contents	= $4\frac{1}{5}$ cu. ft.
1 cu. ft. of water	= $62\frac{1}{2}$ lb.
1 gal. of water	= $8\frac{1}{8}$ lb.
1 cu. ft. of any liquid	= $7\frac{1}{2}$ gal.
1 ton of clover hay	= 550 cu. ft.
1 ton of hard (anthracite) coal	= 35 cu. ft.

16. A water meter registers 900 gal. of water consumed in a month. Estimate the weight of the water used and its volume in cubic feet.

17. The inside measurement of a wagon box is 12 ft. 4 in. by 3 ft. 6 in. by 16 in. Estimate the number of tons, etc., of hard coal it would contain.

18. The rainfall on a flat roof 20 ft. by 30 ft. during April and May is 9.5 in. Find the weight of the water that falls on the roof during that time.

19. A swimming pool is 80 ft. long, 60 ft. wide, and 5 ft. deep. Estimate approximately the number of barrels of water in the pool.

20. Estimate the number of bushels in a bin for oats 14 ft. long and 10 ft. wide, if the bin is filled with oats to a depth of 6 ft.

21. How many tons of hard coal are there in a bin 12 ft.  $\times$  16 ft., when the pile is 1 ft. high?

22. There are 5 ft. of water in a cistern 4 ft. square. How many gallons of water are there in the cistern?

23. Find the weight of the water in a railroad tank 12 ft. square and 16 ft. in depth, if the tank has 12 ft. of water in it.

24. How many bushels of wheat can be shipped in a car whose inside measurements are 36 ft. by  $8\frac{1}{2}$  ft. by 8 ft.?

25. Estimate the number of tons of clover hay in a mow 60 ft. by 18 ft. by 16 ft.

26. Mr. Ford builds a silo 20 ft. in diameter, inside measurement, and 25 ft. in height. How many cubic feet of silage (green corn fodder) will it hold? It is estimated that this silo when full will hold 143 tons of silage. Find from this the weight of a cubic foot of silage.

27. On the tops of three buildings there are round tanks to hold water for use in case of fire. They are, respectively, 7 ft., 8 ft., and 9 ft. in diameter, and 10 ft. in height. About how many gallons of water will each hold?

28. About how much water will a water main hold that is 20 ft. in length, with an inside diameter of 15 in.?

29. A small town has a cylindrical water tank to supply the water. It is 30 ft. in diameter and 30 ft. in height. How many gallons, approximately, will it hold?

30. William measures the depth of the water in his father's well and finds it to be 8 ft. The well is 5 ft. in diameter. Estimate the number of barrels of water in the well.

31. An oil tank of a railroad car is 30 ft. in length and  $4\frac{1}{2}$  ft. inside diameter. How many gallons of oil, approximately, will it hold?

32. A piece of stovepipe is 30 in. in length and 8 in. inside diameter. Find, to hundredths, how many cubic inches of air there are in the stovepipe.

33. Find the weight of the water in a railroad tank 12 ft. in diameter and 16 ft. in depth, if the tank has 12 ft. of water in it.

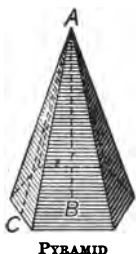
34. A farmer has a windmill pump to pump the water to a trough for the cattle. The trough is 2 ft. wide, 15 ft. long, and 18 in. in depth. About how many barrels of water will it hold?

35. Estimate the number of tons of clover hay in a mow 50 ft. by 14 ft. by 16 ft.

36. A water wagon has a tank 12 ft. in length and  $3\frac{1}{2}$  ft. in diameter. Find approximately, to the nearest tenth of a barrel, the number of barrels it will hold.

## PYRAMIDS AND CONES

## Surfaces



PYRAMID

A solid whose base is a regular polygon, and whose faces are triangles that meet at a point (the *vertex*), is called a **pyramid**.

Pyramids are named from their bases, as, **triangular**, **square**, **pentagonal**, etc.

The altitude of the triangles that bound a pyramid is called the **slant height**.

A solid whose base is a circle, and whose convex surface tapers uniformly to a point called the *vertex*, is called a **cone**.

The perpendicular distance from the vertex to the base of a cone or a pyramid is called the **altitude**.

The distance between the vertex and any point in the circumference of the base of the cone is called its **slant height**.

The convex surface of a pyramid or a cone may be considered as composed of many triangles. The bases of the triangles in both pyramid and cone form the perimeter of the base of the figure, and the altitude of the triangles the slant height. Hence,

*The convex surface of a pyramid or of a cone is found by multiplying the unit of measure by one half the product of the perimeter of the base and the slant height.*

$$\text{FORMULA:} \quad S = \frac{P \times s}{2} \quad S = \pi r \times s.$$



CONE

## Written Work

Find the convex surface of a pyramid or a cone :

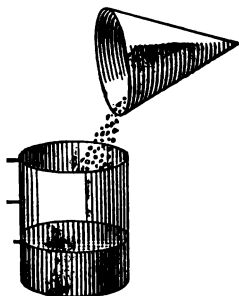
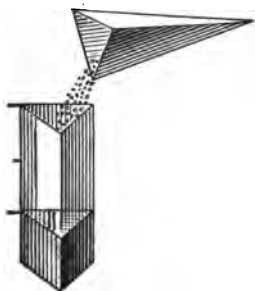
1. Diameter of base of cone, 9 ft.; sl. height, 12 ft.
2. One side of a square pyramid, 16 ft.; sl. height, 24 ft.



3. One side of a square pyramid, 5 ft.; sl. height, 16 ft.
4. A church spire is in the form of a hexagonal pyramid, each side being 10 ft. and the slant height 65 ft. Find the cost of painting it at 37¢ a square yard.

### Volumes

1. Fill a hollow pyramid with sand. Empty it into a prism having the same base and altitude. How often must the pyramid be filled and emptied to fill the prism? The volume of a pyramid, then, is what part of the volume of the prism?



2. Measure, in like manner, with a cone, the volume of a cylinder having the same dimensions. The volume of the cone is what part of the volume of the cylinder?

Observe: 1. That the dimensions of the pyramid and of the prism represented in the picture are the same, and that those of the cone and of the cylinder are the same.

2. That the volume of the pyramid is  $\frac{1}{3}$  that of the prism, and the volume of the cone is  $\frac{1}{3}$  that of the cylinder.

*The volume of a pyramid equals one third of the volume of a prism of like dimensions.*

*The volume of a cone equals one third of the volume of a cylinder of like dimensions.*

You have learned that the volume of a prism or of a cylinder is found by multiplying its unit of measure by the product of the area of the base by the altitude.

*The volume of a pyramid or of a cone is found by multiplying the unit of measure by one third the product of the area of the base by the altitude.*

$$\text{FORMULA: } V = \frac{B \times h}{3}. \quad V = \frac{\pi r^2 \times h}{3}.$$

### Written Work

1. Find the volume of a cone whose altitude is 12 in. and whose base is 8 in. in diameter.
2. Find the volume of a pyramid whose base is 12 in. square and whose altitude is 30 in.
3. A square pyramid whose side is 18 in. is 32 in. high. Find its volume.
4. Find the volume of a cone whose altitude is 10 ft. and whose base is 6 ft. in diameter.

### APPLICATIONS OF GEOMETRIC MEASUREMENTS

1. A field containing 20 A. is 64 rd. long. How wide is it?
2. The area of the floor of a schoolroom contains 1120 sq. ft. The air in the room occupies 16,800 cu. ft. What is the height of the ceiling?
3. How many tiles 6 in. square are required for a hall 40 ft. by 20 ft. 6 in.?
4. The side of a square table cover is 20 in. Find its area; its perimeter.
5. The edge of a cubical packing case is 18 in. Find its surface; its contents.

6. How many cubical boxes whose edges are 6 in. can be put into a box 8 ft. 6 in. by 4 ft. 6 in. by 3 ft.?

7. How many cakes of soap 4 in.  $\times$  2 in.  $\times$  2 in. can be packed in a box 2 ft. long, 1 ft. wide, and 1 ft. high?

8. The edges of two cubical hat boxes are respectively 12 in. and 14 in. How much more surface has one than the other?

9. Find the cost of a farm, 320 rd. wide and 480 rd. long, at \$60 an acre.

10. How much does it cost to put a wire fence around this farm at 50¢ a rod?

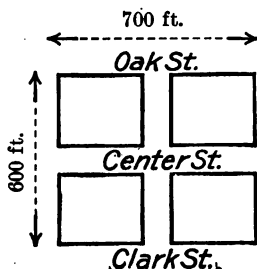
11. A ranchman buys 1 sq. mi. of land at \$10 an acre. He puts a fence around it and then divides it by fences into four equal square farms. Find the entire cost if the fence costs \$.40 a rod.

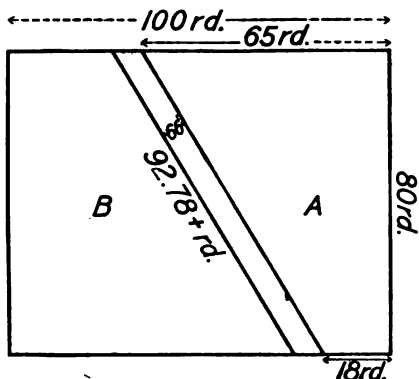
12. A level lot 60 ft. by 120 ft. has a dwelling erected on it 36 ft. by 42 ft. If the excavating averages 5 ft. and the removed earth is placed on the lot, to what height will it raise the grade of the lot?

13. A certain town has a cylindrical water tank 20 ft. in diameter and 45 ft. in height. The gauge shows 30 ft. of water in the tank. Estimate the weight of the water.

14. How many yards of carpet, 1 yd. wide, are required for a room 21 ft. by 24 ft.?

15. This plot of ground is 600 ft. wide and 700 ft. long. Find the cost of grading streets 40 ft. in width run through the center each way, as here shown, at \$1.90 a square yard. Find the amount from the sale of all the lots (30'  $\times$  140') facing on Oak, Center, and Clark streets, at \$20 a front foot.





16. A railroad company owns a strip of land in the form of a parallelogram, 66 ft. wide and  $92.78^+$  rd. long through this farm. Find the area of *A* and the area of the part owned by the railroad. Find the area of *B*.

17. A wheel is 3 ft. in diameter. How many

revolutions does it make in moving forward a distance of 942.48 ft.?

18. Lead is 11.35 times as heavy as water. Find the value of a cubic foot of lead at 5¢ a pound.

19. The base of a triangle is 30 ft. and its altitude is 23 ft. Find its area.

20. A barn is 50 ft. by 80 ft. It is 40 ft. to the base of the gable and 58 ft. to the top of the gable. How much does it cost to paint the sides and the gable ends at 37¢ a square yard?

21. If the slope of the roof of the barn in Ex. 20 is 32 ft. long, and it projects  $1\frac{1}{2}$  ft. at each end, how much does it cost to roof it at \$8 per square of 100 square feet?

22. A schoolroom is 30 ft. wide and 40 ft. long. Estimating 450 cu. ft. of air to each person, what should be the height of the room to accommodate 39 pupils and their teacher?

23. How much does it cost to cement the floor of a cellar, 20 ft. by 40 ft., at 90¢ a square yard?

24. A street 50 ft. from curb to curb is opened for a distance of 300 yd. How much does it cost to excavate it to a depth of 1 ft., at 40¢ a cubic yard?

25. How much does the curb of this street cost at 26¢ a linear foot?

26. A farmer builds a circular silo 12 ft. in diameter and 24 ft. high. Find its contents in cubic feet.

27. How many blocks of ice, 2 ft.  $\times$  1 ft.  $\times$  1 ft., can be packed in a car 40 ft.  $\times$  8 ft.  $\times$  6 ft.? Ice is .92 as heavy as water. Find the weight of the ice.

28. A cistern is 4 ft. in diameter and 6 ft. deep. How many barrels, approximately, of water will it contain?

29. Estimate the weight of water in a tank 8 ft. long, 6 ft. wide, and 2 ft. deep.

30. A vault is 5 ft. square and 6 ft. deep. How much will it cost to cement the sides and the bottom at \$.50 a square foot?

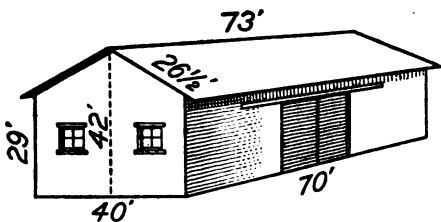
31. A circular amusement park is 80 rd. in diameter. Find the cost of 1-inch boards for a tight board fence 8 ft. high, inclosing the park, at \$20 per M.

32. A corner lot is 25 ft. by 100 ft. At \$25 per M, what will be the cost for 2-inch plank for a 10-foot sidewalk in front and on the side, including the corner?

NOTE. — Illustrate by diagram.

33. Mr. Ames owns a 50-foot lot fronting on a street 60 ft. wide from curb to curb. The law compels him to pay  $\frac{1}{3}$  of the cost of paving the street in front of his lot. How much will it cost, at \$2.90 a square yard?

34. A tank open at the top is 50 ft. long, 4 ft. wide, and 3 ft. deep. How much does the lead for lining it cost, at 8¢ a pound, estimating 4 pounds to a square foot?



35. Find the cost of painting the sides and ends of this hay barn at 36¢ a square yard; also the cost of staining the roof at 30¢ a square yard.

36. In excavating for a cellar 30 ft. wide, 60 ft. long, and 8 ft. deep, the material is evenly distributed over a lot 40 ft. by 90 ft. To what depth is the lot covered?

37. A two-story school building has 8 rooms 30 ft.  $\times$  32 ft. and a hallway 15 ft.  $\times$  28 ft., on each floor. How much does the flooring for the building cost at \$64 per M?

38. From an artesian well 2 in. in diameter the water flows out at the rate of  $1\frac{1}{2}$  ft. a second. Find the number of barrels that flow out per hour.

39. One cubic inch of gold could be pounded into how many square inches of gold leaf  $\frac{1}{1000}$  of an inch in thickness?

40. A copper ingot containing 1 cu. ft. is to be drawn into a copper wire  $\frac{1}{10}$  in. in diameter. Find the length in feet of the wire when drawn.

41. A western farmer has a pile of corn in the ear, 400 ft. long. The pile at the end is in the form of an isosceles triangle, 12 ft. wide at the bottom, and the altitude of the pile is 6 ft. Find the number of bushels, allowing  $1\frac{1}{3}$  cu. ft. to a bushel.

42. What is the convex surface of a piece of stovepipe 2 ft. long and 8 in. in diameter?

43. The flow of water from the same source through two different pipes depends upon the area of the cross section of the openings. Compare the flow through a  $\frac{1}{2}$ -inch pipe with the flow through a  $\frac{3}{4}$ -inch pipe.

## POWERS AND ROOTS

1.  $3 \times 3 = 9$ .  $4 \times 4 = 16$ .  $5 \times 5 \times 5 = 125$ .
2. Name the *two* equal factors that produce 9; 16.
3. Name the *three* equal factors that produce 125.
4. What *two* equal factors produce 25? 36? 49? 81?
5. What *three* equal factors produce 8? 27? 64?
6. How many times is 5 used as a factor in 5? in 25? in 125?
7. How many times is 3 used as a factor in 3? in 9? in 27?

The product obtained by taking a number a certain number of times as a factor is called a **power** of the number. Thus, 9 is a power of 3, and 8 is a power of 2.

The *second* power of a number is called the **square** of the number. Thus, 16 is the square of 4. The *third* power of a number is called the **cube** of the number. Thus, 64 is the cube of 4.

8. What is the square of 4? 5? 6? 7? 8? 9?
9. What is the cube of 2? 3? 5? 6? 7?
10.  $\frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$ . What, then, is the square of  $\frac{2}{3}$ ?
11.  $\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{27}{64}$ . What, then, is the cube of  $\frac{3}{4}$ ?
12.  $.3 \times .3 = .09$ .  $.5 \times .5 = .25$ . What, then, is the square of .3? of .5?

*The square of a fraction is found by squaring both terms; the cube of a fraction, by cubing both terms.*

13.  $3 \times 3 = 9$ . The square of 3 is indicated thus,  $3^2$  (read "3 square").  $4 \times 4 \times 4 = 64$ . The cube of 4 is indicated thus,  $4^3$  (read "4 cube").

14. How much is  $5^2$ ?  $6^2$ ?  $7^2$ ?  $5^3$ ?  $6^3$ ? What is the value of  $(\frac{3}{4})^2$ ?  $(\frac{2}{3})^3$ ?  $.4^2$ ?  $.4^3$ ?  $(2\frac{1}{2})^2$ ?

A small figure placed at the right of, and a little above, a number, to indicate the number of times it is to be taken as a factor is called an **exponent**. Thus,  $4^3 = 4 \times 4 \times 4 = 64$ . Exponent, 3.

### Written Work

1. Square 6, 7, 8, 9, 10, 12, 15.
2. Cube 3, 4, 5, 6, 7, 8, 9, 10, 12.
3. Square 30, 50, 60, 80, 120.
4. Cube 20, 30, 40, 50, 100.
5. Find the value of  $11^2$ ,  $13^2$ ,  $14^2$ ,  $11^3$ ,  $15^3$ ,  $60^3$ .
6. Find the value of  $(\frac{3}{5})^2$ ,  $(\frac{2}{5})^3$ ,  $(\frac{3}{4})^2$ ,  $(\frac{4}{5})^3$ ,  $(\frac{3}{7})^2$ ,  $(1\frac{1}{2})^2$ .
7. Square .3, .04, .05, .6, .06. Cube .4, .04, .6.

Find the value of:

- |            |             |                         |
|------------|-------------|-------------------------|
| 8. $17^2$  | 11. $22^2$  | 14. $.75^2$             |
| 9. $16^2$  | 12. $25^2$  | 15. $(1\frac{3}{5})^2$  |
| 10. $18^2$ | 13. $6.5^2$ | 16. $(16\frac{1}{2})^2$ |

Find the number of square units in a square surface whose side is:

- |            |             |             |
|------------|-------------|-------------|
| 17. 19 in. | 20. 28 ft.  | 23. 7.5 yd. |
| 18. 24 ft. | 21. 35 in.  | 24. 8.2 yd. |
| 19. 36 yd. | 22. 8.5 in. | 25. 6.1 mi. |

Find the number of cubic units in a cube whose edge is:

- |             |             |             |
|-------------|-------------|-------------|
| 26. 14 in.  | 28. 3.9 ft. | 30. 9.5 yd. |
| 27. 3.5 ft. | 29. 42 in.  | 31. 7.5 ft. |



## EXTRACTING ROOTS

One of the equal factors of a number is called a **root**. Thus, 3 is a root of 9.

One of the *two* equal factors of a number is called its **square root**. Thus, 4 is the square root of 16.

One of the *three* equal factors of a number is called its **cube root**. Thus, 4 is the cube root of 64.

1. What is the square root of 25? 36? 49? 81? 100?

2. What is the cube root of 8? 64? 125? 216?

The root of a number is generally indicated by writing the number under the *radical or root sign*  $\sqrt{\quad}$ , and placing a figure called the *index* in the angle of the sign. Thus,  $\sqrt[3]{27}$  denotes the cube root of 27. The square root is indicated by  $\sqrt{\quad}$  without the index.

*The root of a fraction equals the root of the numerator divided by the same root of the denominator.*

Find the required root: Thus,  $\sqrt{64} = \sqrt{8 \times 8} = 8$ .

3.  $\sqrt{121}$       8.  $\sqrt[3]{\frac{64}{1000}}$       13.  $\sqrt[3]{2744}$       18.  $\sqrt[3]{64,000}$

4.  $\sqrt{144}$       9.  $\sqrt{625}$       14.  $\sqrt[3]{8000}$       19.  $\sqrt{196}$

5.  $\sqrt{\frac{49}{81}}$       10.  $\sqrt[3]{1728}$       15.  $\sqrt[3]{1331}$       20.  $\sqrt{256}$

6.  $\sqrt{225}$       11.  $\sqrt[3]{\frac{27}{125}}$       16.  $\sqrt[3]{27,000}$       21.  $\sqrt{2500}$

7.  $\sqrt{400}$       12.  $\sqrt{900}$       17.  $\sqrt[3]{.064}$       22.  $\sqrt{8100}$

**Some perfect powers and their roots.**

Memorize :

$\sqrt{1} = 1$	$\sqrt{36} = 6$	$\sqrt[3]{1} = 1$	$\sqrt[3]{216} = 6$
$\sqrt{4} = 2$	$\sqrt{49} = 7$	$\sqrt[3]{8} = 2$	$\sqrt[3]{343} = 7$
$\sqrt{9} = 3$	$\sqrt{64} = 8$	$\sqrt[3]{27} = 3$	$\sqrt[3]{512} = 8$
$\sqrt{16} = 4$	$\sqrt{81} = 9$	$\sqrt[3]{64} = 4$	$\sqrt[3]{729} = 9$
$\sqrt{25} = 5$	$\sqrt{100} = 10$	$\sqrt[3]{125} = 5$	$\sqrt[3]{1000} = 10$

**How to find the root of a perfect square or cube by factoring.**

### Written Work

1. Find the square root of 1225.

When factored  $1225 = 5 \times 5 \times 7 \times 7$ .

Arranged into *two* like groups  $1225 = (5 \times 7) \times (5 \times 7)$ .

$$\sqrt{1225} = 5 \times 7, \text{ or } 35.$$

To find the cube root, factor as above and arrange the factors in *three* like groups.

- Find the root of each number, as indicated, by factoring:

- |                 |                     |                       |                       |
|-----------------|---------------------|-----------------------|-----------------------|
| 2. $\sqrt{289}$ | 6. $\sqrt{784}$     | 10. $\sqrt{1764}$     | 14. $\sqrt{5184}$     |
| 3. $\sqrt{576}$ | 7. $\sqrt{1296}$    | 11. $\sqrt[3]{13824}$ | 15. $\sqrt[3]{15625}$ |
| 4. $\sqrt{441}$ | 8. $\sqrt[3]{4096}$ | 12. $\sqrt{8136}$     | 16. $\sqrt[3]{32768}$ |
| 5. $\sqrt{324}$ | 9. $\sqrt{2304}$    | 13. $\sqrt[3]{5832}$  | 17. $\sqrt{4096}$     |

### SQUARE ROOT

#### Comparing roots and periods.

The **squares** of the smallest and the largest integers composed of one, two, and three figures are as follows:

$1^2 = 1$	$10^2 = 100$	$100^2 = 10,000$
$9^2 = 81$	$99^2 = 9801$	$999^2 = 998,001$

1. Separate each of these squares into periods of two figures each, beginning at the right; thus, 99' 80' 01.

2. How does the *number of periods* in each square compare with the *number of figures* in the corresponding roots?

*The number of periods of two figures each, beginning at units, into which a number can be divided equals the number of figures in the root.*

**NOTE.** The left-hand period may contain only one figure.

3. How many figures are there in the square root of 4225? of 12,544? of 133,225? of 810,000?

## Written Work

1. Square 25.  $25 = 20 + 5$ , hence it may be squared in two ways, thus:

$$\begin{array}{rcl}
 25 & = & 20 + 5 \\
 25 & = & 20 + 5 \\
 \hline
 125 & = & 20 \times 5 + 5^2 \\
 50 & = & 20^2 + 20 \times 5 \\
 \hline
 625 & = & 20^2 + 2(20 \times 5) + 5^2
 \end{array}
 \quad
 \begin{array}{l}
 \text{The square of 25 has three partial} \\
 \text{products:} \\
 25^2 = \left\{ \begin{array}{l} (1) \quad 20^2 = 400 \\ (2) \quad 2(5 \times 20) = 200 \\ (3) \quad 5^2 = 25 \end{array} \right\} = 625
 \end{array}$$

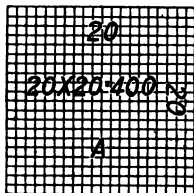
2. Find the square root of 625.

$$\begin{array}{r}
 6'25 \overline{) 20} \\
 \underline{20^2 = 400} \phantom{00} \\
 \text{Trial divisor, } 2 \times 20 = 40 \overline{) 225} \phantom{00} \\
 \phantom{00} \underline{5} \phantom{00} \\
 \phantom{00} \phantom{00} \underline{25} \\
 \text{Complete divisor, } = \underline{45} \overline{) 225}
 \end{array}$$

In practice:

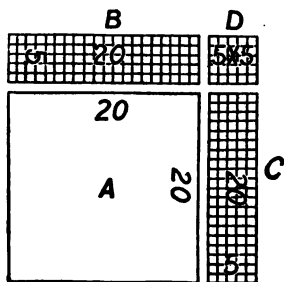
$$\begin{array}{r}
 6'25 \overline{) 25} \\
 \underline{4} \phantom{00} \\
 45 \overline{) 225} \\
 \phantom{00} \underline{225}
 \end{array}$$

Since 625 has two periods, its square root is composed of two figures, tens and ones. Since the square of *tens* is *hundreds*, 6 hundreds must be the square of at least 2 tens. Two tens or 20 squared is 400, as shown in figure A;  $625 - 400$  leaves a remainder of 225. The root 20, therefore, must be so increased as to exhaust this remainder and keep the figure a square.



The necessary additions to enlarge A and keep it a square are the two equal rectangles B and C, and the small square D.

B, C, and D contain 225 square units; and since the area of D is small, if 225 is divided by 40, the combined length of B and C, the quotient will indicate the approximate width of these additions. The quotient is 5; the entire length of B, C, and D is  $20 + 20 + 5$ , or 45 units; and the area of the additions is 5 times 45 sq. units, or 225 sq. units. Since these three additions exhaust the remaining 225 sq. units, and keep the figure a square, the side of the required square is 25 units, and the square root of 625 is 25.



3. Square 35 ( $30 + 5$ ); then find the square root of 1225.

$$\begin{array}{rcl}
 \text{Partial} & \left\{ \begin{array}{l} (1) \quad 30^2 = 900 \\ (2) \quad 2 \times (5 \times 30) = 300 \\ (3) \quad 5^2 = 25 \end{array} \right. & \\
 \text{Products:} & & \\
 & \begin{array}{r} 12'25 \overline{) 30} \\ 9 \ 00 \overline{) 5} \\ 3 \ 25 \overline{) 35} \\ 5 \overline{) 65} \end{array} & \\
 \text{Trial divisor, } 2 \times 30 = 60 & & \\
 \text{Complete divisor, } & \begin{array}{r} 65 \ 3 \ 25 \end{array} & 
 \end{array}$$

1. How many periods are there in 1225?

2. How many figures, then, will there be in its root?

3. What is the largest partial product in 1225?

4. What is the square root of 900?

5. What two partial

products are contained in the 325 remaining?

6. 325 is composed principally of which partial product?  $2(5 \times 30)$ .

325 is composed principally of 2 times the first figure of the root by the second. Hence, if 325 is divided by  $(2 \times 30)$ , the quotient will give approximately the second figure of the root.

7. What is the quotient? the second figure of the root?

8. What must be added to the trial divisor  $(2 \times 30)$  to form the complete divisor?

Since  $5 \times 65 = 325$ , the second root figure is 5, and  $30 + 5$ , or 35, is the square root of 1225.

4. Find the square root of 2134.44. Separate the number into periods, left and right from the decimal point.

$$\begin{array}{rcl}
 & 21'34'.44 \overline{) 46.2} & \\
 40^2 = 16 \ 00 & & \\
 \text{Trial divisor, } 2 \times 40 = 80 & \begin{array}{r} 5 \ 34 \\ 6 \\ 86 \end{array} & \\
 \text{Complete divisor, } & \begin{array}{r} 86 \ 5 \ 16 \end{array} & \\
 \text{Trial divisor, } 2 \times 460 = 920 & \begin{array}{r} 18 \ 44 \\ 2 \end{array} & \\
 \text{Complete divisor, } & \begin{array}{r} 922 \ 18 \ 44 \end{array} & 
 \end{array}$$

In practice:

$$\begin{array}{rcl}
 21'34'.44 \overline{) 46.2} & & \\
 16 & & \\
 86 \begin{array}{r} 5 \ 34 \\ 5 \ 16 \\ 18 \ 44 \end{array} & & \\
 922 \begin{array}{r} 18 \ 44 \end{array} & & 
 \end{array}$$

Beginning at units, separate the number into periods of two figures each.

*Find the largest square in the first period on the left, and write its root as the first figure in the required root. Subtract its square from the period and annex the second period to the remainder.*

*Double the root found for a trial divisor. Divide the remainder, omitting the right-hand figure, by this trial divisor, and annex the quotient to the trial divisor and also to the root.*

*Multiply the complete divisor by the second figure of the root, and subtract the product from the remainder.*

*Double the root already found for another trial divisor, and proceed as above until all the periods have been used.*

**NOTE.** When a zero occurs in the root, annex a zero to the trial divisor, bring down another period, and proceed as before.

In extracting the square root of a *decimal* or a *whole number* and a *decimal*, point off into periods of two figures each, the whole number toward the left and the decimal toward the right of the decimal point.

In extracting the square root of a *fraction*, extract the square root of the numerator and of the denominator if both terms are perfect squares; or reduce the fraction to a decimal, and extract the root of the decimal.

**NOTE.** For table of squares of numbers to 100, and corresponding square roots, see p. 318.

Find the following:

- |                 |                   |                              |                    |
|-----------------|-------------------|------------------------------|--------------------|
| 5. $\sqrt{484}$ | 9. $\sqrt{1089}$  | 13. $\sqrt{\frac{81}{100}}$  | 17. $\sqrt{.0225}$ |
| 6. $\sqrt{729}$ | 10. $\sqrt{1849}$ | 14. $\sqrt{\frac{121}{225}}$ | 18. $\sqrt{.441}$  |
| 7. $\sqrt{676}$ | 11. $\sqrt{2601}$ | 15. $\sqrt{\frac{169}{324}}$ | 19. $\sqrt{6.25}$  |
| 8. $\sqrt{961}$ | 12. $\sqrt{3969}$ | 16. $\sqrt{.25}$             | 20. $\sqrt{.0625}$ |

Find the square root of:

- |            |             |                         |             |
|------------|-------------|-------------------------|-------------|
| 21. 2401   | 26. 182.25  | 31. 96.8256             | 36. .8464   |
| 22. 5329   | 27. 14884   | 32. $192\frac{33}{64}$  | 37. .012996 |
| 23. 1156   | 28. 26569   | 33. $540\frac{9}{16}$   | 38. .000576 |
| 24. 4356   | 29. 136161  | 34. $3192\frac{1}{4}$   | 39. .436921 |
| 25. 210.25 | 30. 20.7936 | 35. $5643\frac{49}{64}$ | 40. 112225  |

## METRIC SYSTEM OF WEIGHTS AND MEASURES

**NOTE.** Because of its growing importance, the metric system has been included in the eighth year's work instead of being placed in the Supplement. Teachers who feel that the time may be more profitably devoted to other subjects can omit this section without interrupting the sequence.

By the United States system of money we may write 5 dollars, 9 dimes, and 7 cents thus, \$5.97, because there is a uniform ratio between the dollar and the dime, the dollar and the cent, the dollar and the mill; the dollar being 10 times the dime, 100 times the cent, and 1000 times the mill.

As a mill is  $\frac{1}{1000}$  of a dollar, a cent  $\frac{1}{100}$  of a dollar, and a dime  $\frac{1}{10}$  of a dollar, *United States money* is based on a decimal system.

By the English long measure, 12 in. = 1 ft., 3 ft. = 1 yd., and  $5\frac{1}{2}$  yd. = 1 rd. Thus we see that there is no uniform ratio between the rod and the yard, the rod and the foot, and the rod and the inch, the rod being  $5\frac{1}{2}$  times the yard,  $16\frac{1}{2}$  times the foot, and 198 times the inch.

By the English measure of weights, 16 oz. = 1 lb., 100 lb. = 1 cwt., 20 cwt. = 1 ton. The ton equals 20 times the hundredweight, 2000 times the pound, and 32,000 times the ounce.

The metric system was devised by the *French* government in an effort to establish a system of weights and measures that would be on a uniform decimal scale, so that a unit of one denomination might be changed to a unit of another denomination by simply moving the decimal point.

The meter is the fundamental unit of the metric system.

From the meter every other unit of measure or weight is derived. Thus, the unit of **weight** is the **gram**, which equals the weight of 1 cubic centimeter of pure water.

Draw a cube .01 of a meter on an edge and state the length of the edge in inches.

The unit of **capacity** is the **liter** (lêter), which contains 1 cubic decimeter.

Draw a cube .1 of a meter on an edge and state the length of the edge in inches.

The metric system is now in use in most of the civilized countries except Great Britain and the United States, and in the latter it is in use in some of the departments of the government. It is the official system adopted by Congress for our island possessions. It is universally used by scientists. The United States by a vote of Congress permitted its use in 1866.

Observe :

The **meter** measures length.

The **square meter** measures surface.

The **cubic meter** measures solids or volume.

The **gram** measures weight.

The **liter** measures capacity.

**Latin prefixes.**

To express .1 of a meter, .1 of a gram, and .1 of a liter, we prefix **dec**i to each of the words, meter, gram, and liter. Thus, **decimeter** means  $\frac{1}{10}$  of a meter ; **decigram**,  $\frac{1}{10}$  of a gram ; and **deciliter**,  $\frac{1}{10}$  of a liter.

To express .01 of a meter, gram, and liter, we prefix **centi** to each of the words, meter, gram, and liter.

To express .001 of a meter, gram, and liter, we prefix **milli** to each of the words, meter, gram, and liter.

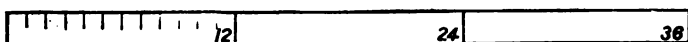
**NOTE.** From these Latin prefixes we get our words *dime*, *cent*, and *mill*.

**Greek prefixes.**

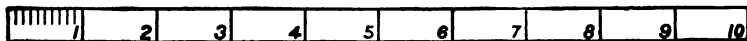
To express **10** times a meter, **10** times a gram, and **10** times a liter, we prefix **deka** to each of the words, meter, gram, and liter. Thus, **dekameter** means **10** times a meter; **deka-gram** **10** times a gram; and **dekaliter**, **10** times a liter.

To express **100** times a meter, gram, and liter, we prefix **hekto** to each of the words, meter, gram, and liter.

To express **1000** times a meter, gram, and liter, we prefix **kilo** to each of the words, meter, gram, and liter.

**METRIC MEASURES OF LENGTH****Comparison of Fundamental Units of Measures of Length**

1 YARD



1 METER

**Table of Long Measure**

<b>1 millimeter</b> (mm.)	= .001 of a meter
<b>1 centimeter</b> (cm.)	= .01 of a meter
<b>1 decimeter</b> (dm.)	= .1 of a meter (nearly 4 in.)
<b>1 meter</b>	= <b>39.37 in.</b>
<b>1 dekameter</b> (Dm.)	= 10 meters
<b>1 hektometer</b> (Hm.)	= 100 meters
<b>1 kilometer</b> (Km.)	= 1000 meters (.6 mi.)

*In metric measures of length 10 times one unit of any denomination equals one unit of the next higher denomination.*

The denominations most frequently used are given in black-faced type.



Approximately :

$$1 \text{ yard} = \frac{11}{13} \text{ meter} \qquad 1 \text{ mile} = 1.6 \text{ kilometer}$$

The **kilometer** is used for measuring long distances; the **meter**, for short distances and for measuring cloth, etc.; and the **millimeter** is used in the sciences and to show very small measurements, as the thickness of wire, etc.

### Written Work

1. What decimal parts of a meter are expressed by the Latin prefixes? What multiples are expressed by the Greek prefixes?

2. Draw a line one meter long. Show the number of decimeters in a meter; the number of centimeters; the number of millimeters.

3. Explain why  $5 \text{ m.} = 50 \text{ dm.} = 500 \text{ cm.} = 5000 \text{ mm.}$

4. Add  $8 \text{ m. } 5 \text{ dm. } 6 \text{ cm. } 25 \text{ mm.}$

### SOLUTION

Added in meters:

$$\begin{array}{r} 8 \text{ m.} = 8 \text{ m.} \\ 5 \text{ dm.} = .5 \text{ m.} \\ 6 \text{ cm.} = .06 \text{ m.} \\ 25 \text{ mm.} = .025 \text{ m.} \\ \hline 8.585 \text{ m.} \end{array}$$

Added in millimeters:

$$\begin{array}{r} 8 \text{ m.} = 8000 \text{ mm.} \\ 5 \text{ dm.} = 500 \text{ mm.} \\ 6 \text{ cm.} = 60 \text{ mm.} \\ 25 \text{ mm.} = 25 \text{ mm.} \\ \hline 8585 \text{ mm.} \end{array}$$

5. Add  $1 \text{ m., } 3 \text{ dm., } 6 \text{ cm., } 3 \text{ mm.}$  Add  $6.5 \text{ m., } 25 \text{ mm.}$

6. The distance between two towns is  $5 \text{ Km.}$  and  $45 \text{ m.}$  After a bicyclist has traveled  $3 \text{ Km., } 57 \text{ m.,}$  how much of the distance remains to be traveled?

SOLUTION.  $5 \text{ Km. } 45 \text{ m.} = 5.045 \text{ Km.}$

$$\underline{3 \text{ Km. } 57 \text{ m.} = 3.057 \text{ Km.}}$$

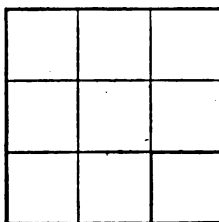
$1.988 \text{ Km., or } 1 \text{ Km. } 988 \text{ m.}$

7. The distance from Paris to Calais is  $295.32 \text{ Km.}$  Express this distance approximately in miles. (Use  $1 \text{ Km.} = .6 \text{ mi.}$ )

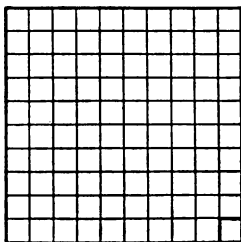
8. How many meters of ribbon are necessary to make 150 badges, each 25 cm. in length?
9. The distance from Erie, Pa., to Buffalo, N. Y., is 112.65 Km. Express the distance in miles (1 Km. = .6 mi.).
10. The distance from New York to San Francisco is 4000 mi. Express this distance in kilometers (1 mi. = 1.6 Km.).

## METRIC MEASURES OF SURFACE

### Comparison of Fundamental Units of Square Measure



1 SQUARE YARD



1 SQUARE METER

### Table of Square Measures

1 sq. millimeter (sq. mm.)	= .000001 sq. meter
1 sq. centimeter (sq. cm.)	= .0001 sq. meter
1 sq. decimeter (sq. dm.)	= .01 sq. meter
1 sq. meter (sq. m.)	= 1.196 sq. yd.
1 sq. dekameter (sq. Dm.)	= 100 sq. meters
1 sq. hektometer (sq. Hm.)	= 10,000 sq. meters
1 sq. kilometer (sq. Km.)	= 1,000,000 sq. meters (nearly .4 sq. mi.)

*In metric measures of surface 100 times one unit of any denomination equals one unit of the next higher denomination.*

**Land Measure.**

The standard unit used for measuring land is the **are** (â), which equals 100 square meters or 119.6 square yards.

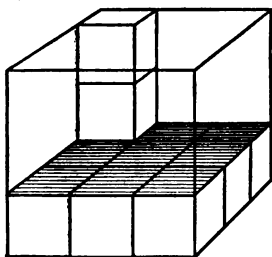
Table:

1 centare = 1 sq. meter

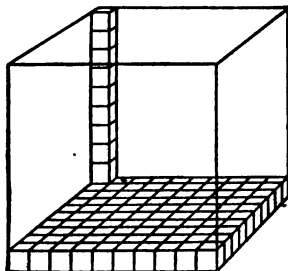
1 are = 100 sq. meters (nearly 120 square yards)

1 hektare = 10,000 sq. meters (nearly  $2\frac{1}{2}$  acres)

The **square meter** is used for measuring ordinary surfaces, such as are found in houses, lots, farms, etc.; the **square kilometer**, for measuring areas of countries and their divisions into states, counties, etc.

**METRIC MEASURES OF VOLUME****Comparison of Fundamental Units of Cubic Measure**

1 CUBIC YARD



1 CUBIC METER

**Table of Solid or Cubic Measures**

1 cu. millimeter (cu. mm.)	= .000000001 cu. meter
1 cu. centimeter (cu. cm.)	= .000001 cu. meter
1 cu. decimeter (cu. dm.)	= .001 cu. meter
1 cu. meter	= 1.308 cu. yd.

*In metric measures of volume 1000 times one unit of any denomination equals one unit of the next higher denomination.*

In measuring wood 1 cubic meter is called a **stere**.

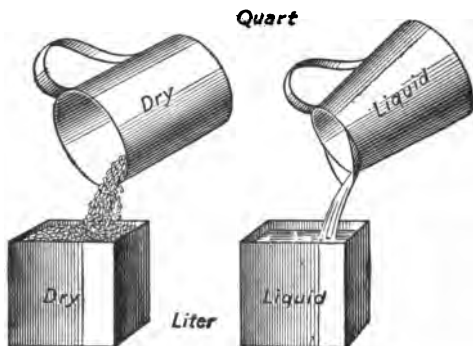
The **cubic meter** is the practical unit of measure of volume for all purposes.

### Written Work

1. Find the number of square meters in the floor of your schoolroom.
2. At 27 cents a cubic meter, find the cost of excavating a cellar 10 m. by 18 m. by  $1\frac{1}{2}$  m.
3. How much does it cost to paint one side of a tight board fence 3 m. wide and 25 m. long, at \$.45 a square meter?
4. How many square meters of linoleum are required to cover the floor of a hall 3 m. wide and 8 m. long?
5. How many steres are there in a pile of wood 6 m. long, 2 m. wide, and 2 m. high?

## METRIC MEASURES OF CAPACITY

### Comparison of Fundamental Units of Capacity



## Table of Measures of Capacity

1 milliliter (ml.)	= .001 of a liter
1 centiliter (cl.)	= .01 of a liter
1 deciliter (dl.)	= .1 of a liter
1 liter	= 1.0567 liquid quarts = .908 dry quart
1 dekaliter (Dl.)	= 10 liters
1 hektoliter (Hl.)	= 100 liters (nearly 2.84 bu.)
1 kiloliter (Kl.)	= 1000 liters

*In metric measures of capacity 10 times one unit of any denomination equals one unit of the next higher denomination.*

The liter is used for liquid and dry measures.

## METRIC MEASURES OF WEIGHT

## Comparison of Units of Weight



1 OUNCE



1 GRAM



1 POUND



1 KILO

## Table of Measures of Weight

1 milligram (mg.)	= .001 of a gram
1 centigram (cg.)	= .01 of a gram
1 decigram (dg.)	= .1 of a gram
1 gram	= .03527 of an oz. Avoir.
1 dekagram (Dg.)	= 10 grams
1 hektogram (Hg.)	= 100 grams
1 kilogram (Kg.)	= 1000 grams (2.2 lb.)
1 myriagram (Mg.)	= 10,000 grams
1 quintal (Q.)	= 100,000 grams
1 tonneau (T.)	= 1,000,000 grams (nearly 2205 lb.)

*In metric measures of weight 10 times one unit of any denomination equals one unit of the next higher denomination.*

The *gram* is the weight of 1 cubic centimeter of water, the *kilogram*, of 1 cubic decimeter, and the *metric ton*, of 1 cubic meter; the *gram* is used by druggists and chemists; the *kilogram* (usually called the *kilo*) for weighing small articles; and the *metric ton* for large, heavy articles.

#### Table of Metrical Equivalents

1 cu. mm. of water weighs 1 mg. and measures .001 ml.
1 cu. cm. of water weighs 1 g. and measures 1 ml.
1 cu. dm. of water weighs 1 Kg. and measures 1 l.
1 cu. m. of water weighs 1 T. and measures 1 Kl.

#### Written Work

Things sold in the United States and in England by the *quart* are sold in countries using the metric system by the *liter*.

1. Estimate the number of liters in a tank  $2\frac{1}{2}$  m. long,  $\frac{3}{4}$  m. wide, and  $\frac{1}{2}$  m. deep.
2. A cylindrical tank 6 m. in diameter and 10 m. in height is  $\frac{2}{3}$  full. Find the number of liters it contains. Find the weight in metric tons.
3. A Paris milkman retails on an average 55 l. of milk daily at 50 centimes a liter. Find in our own money the amount of his sales for 30 days. (50 centimes = 10¢.)
4. The rainfall in a certain place in one week is 1 dm. Find the number of liters that fall on 3 hektares of land.
5. A horse eats 4 l. of oats 3 times a day. How many hektoliters does it eat in 60 days?
6. From an olive orchard, 4.5 Kl. of olive oil are put up in bottles holding .5 l. How many bottles are used?

7. Find the amount in United States money from the sale of 1000 Hl. of wheat at 20 francs a hektoliter. (1 franc = \$.193.)

8. An ice dealer retails blocks of ice .8 m. in length, .3 m. in width, and .2 m. in thickness. The weight of ice is .92 that of the same volume of water. Find its cost at 1¢ per kilo.

9. Change a cubic meter of water to liters.

10. Find the weight of a barrel (196 lb.) of flour in kilos.

11. A stone 9 ft. by 3 ft. by 2 ft. contains how many cubic meters? (Carry answer to thousandths.)

12. If stone is 2.9 times as heavy as the same volume of water, find the weight of the stone in kilos.

13. The Washington Monument is 555 ft. high. Express its height in meters, to hundredths.

14. Find the cost of laying a cement walk .025 Km. in length and 1.5 m. in width, at \$1.70 a square meter.

15. Mr. James has bought a tract of land in the Philippine Islands, 3 Km. in length and 2.5 Km. in width. Find the cost of inclosing this land with wire fence at 15¢ a meter.

16. A hallway is 5 m. wide and 12 m. long. Estimate the number of tiles 1 cm. square necessary to cover it.

17. How many cubic centimeters are there in a book 18 cm. long, 15 cm. wide, and 3 cm. thick?

18. Find the number of cubic centimeters in a brick 20.6 cm.  $\times$  10 cm.  $\times$  5.6 cm.

19. A railroad in building a retaining wall uses 52,000 cu. m. of stone. Find its weight in metric tons if stone is 2.7 times as heavy as the same volume of water.

20. A city sewer is 1.3 Km. in length, 1.2 m. in width, and averages 3 m. in depth. Estimate the number of cubic meters of earth removed in digging it.

## EVERYDAY USE OF NUMBERS

### Increase in Cost of Living

Find, to the nearest tenth per cent, the per cent of increase or decrease in each food price from 1917 to 1918:

	ARTICLE AND UNIT	AVERAGE PRICE, 1917	AVERAGE PRICE, 1918
1.	Sirloin steak, pound . . . . .	\$ 0.327	\$ 0.421
2.	Round steak, pound . . . . .	.366	.403
3.	Rib roast, pound . . . . .	.257	.333
4.	Chuck roast, pound . . . . .	.219	.291
5.	Pork chops, pound . . . . .	.316	.370
6.	Bacon, pound . . . . .	.429	.523
7.	Lard, pound . . . . .	.274	.325
8.	Lamb, pound . . . . .	.299	.420
9.	Hens, pound . . . . .	.280	.380
10.	Eggs, dozen . . . . .	.420	.580
11.	Butter, pound . . . . .	.459	.660
12.	Milk, quart . . . . .	.111	.145
13.	Bread, 16-ounce loaf . . . . .	.088	.087
14.	Flour, pound . . . . .	.072	.067
15.	Onions, pound . . . . .	.051	.053
16.	Prunes, pound . . . . .	.160	.167
17.	Sugar, pound . . . . .	.083	.090
18.	Coffee, pound . . . . .	.306	.301
19.	Tea, pound . . . . .	.599	.653

20. From 1914 to 1918 the increase in the cost of food was 83 %; in shelter, 20 %; in clothing, 93 %; and in fuel and light, 55 %. At this rate, find Mrs. Boyd's expenses for these items in 1918 if in 1914 she spent for food \$600; for shelter, \$400; for clothing, \$300; for fuel and light \$90.

21. From 1898 to 1918 eggs rose in price from \$.15 to \$.58 a dozen, and butter from \$.18 to \$.66 a pound. Find the per cent of increase in each case.



**Farm Accounts**

1. Find the missing numbers represented by ? ; also the loss or gain per acre of wheat as shown by the following account :

**ACCOUNT WITH WHEAT, 40 ACRES**

COST			
Sept. 1918	Seeding in corn	\$ 45.00	
	50 bu. seed	100.00	
Mar. 1919	Breaking down corn stalks	10.00	
June 1919	Twine and cutting	60.00	
Aug. 1919	Threshing 800 bu. @ \$.05	?	
	Meals for threshers	16.00	
	Interest on land investment @ 6 %	480.00	
	Man labor, 240 hr. @ \$.35	?	
	Horse labor, 200 hr. @ \$.20	?	
	Taxes and insurance	10.00	
RETURNS			
	800 bu. wheat @ \$2		?
	44 T. of straw @ \$4		?

2. Find the loss or gain per acre of corn as shown by the following account :

**ACCOUNT WITH CORN, 40 ACRES**

COST			
Apr. 1919	Plowing	\$ 140.00	
	Harrowing	28.00	
May 1919	Seed and planting	50.00	
	Cultivating (four times)	140.00	
	Husking	112.00	
	Taxes and insurance	30.00	
	Interest on land investment	300.00	
RETURNS			
	1800 bu. @ \$1.40		?
	Value of stalks		35.00

### Farm Implements

1. Mr. Ray bought a farm of 104 A. @ \$185. He gave a mortgage for \$14,000 at 6 %. Find the annual interest.

2. Find the total cost of the following implements:

1 corn planter . . . . .	\$ 70.00	1 mower . . . . .	\$80.00
1 hay rake . . . . .	47.50	1 corn binder . . . . .	225.00
2 farm wagons @ . . . .	160.00	1 small wheat drill . . .	60.00
1 spring-tooth harrow . .	80.00	1 large wheat drill . . .	180.00
1 leveling harrow . . . .	35.00	1 clover seeder . . . . .	1.50
1 gang plow . . . . .	110.00	1 oats seeder . . . . .	27.50
3 sets harness @ . . . .	75.00	1 hay loader . . . . .	120.00
1 disk harrow . . . . .	112.00	1 pulverizer . . . . .	85.00
2 riding cultivators @ . .	48.00	1 walking plow . . . . .	25.00
1 manure spreader . . . .	160.00	Small tools for garden,	
1 grain binder . . . . .	250.00	barn, and workshop . . .	40.00

3. What per cent of the investment for land was the investment for implements?

4. What per cent of the total outlay for implements was paid for farm wagons?

5. The first year Mr. Ray raised 800 bu. corn, which he sold @ \$.80, 300 bu. oats @ \$.60, 60 hogs, 200 lb. each, @ \$.12, 200 bu. wheat @ \$2, and 4 calves @ \$45. What per cent of the cost of the tools did the first year's produce yield?

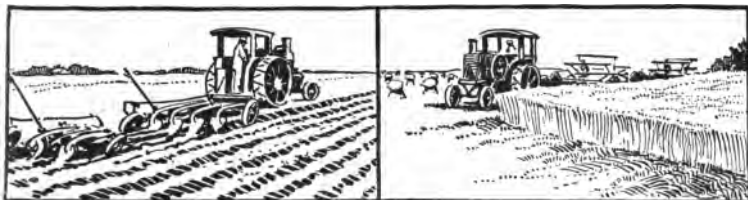
6. What was the value of the farm implements at the end of a year, allowing 5 % for depreciation?

7. At 6 % interest on the investment for implements, and 5 % depreciation, what was the total carrying upkeep?

8. If Mr. Ray had not bought the grain binder, the corn binder, the hay loader, and the large wheat drill, what per cent of his outlay for implements would he have saved?

9. If Mr. Ray had added to his implements 1 farm tractor at \$1200, 1 feed cutter at \$450, and 1 auto truck at \$700, by what per cent would he have increased his outlay?

## Farm Tractors



1. A farmer plowed with his tractor 35 A. of blue grass sod. He used 75 gal. gasoline @ 23¢, 5 gal. oil @ 40¢, and 37 hr. labor @ 30¢. Find the cost per acre of the plowing.

2. In a period of 680 hr. his tractor was out of service only  $4\frac{1}{2}$  hr. What per cent of the time was it out of service?

A farmer made the following record with his tractor:

Plowed 250 A.

Disked 500 A.

Cut, in  $4\frac{1}{2}$  da., 170 A. of oats.

Shelled, in 18 da. (10 hr. each), 25,000 bu. of corn.

Threshed, in 12 da. (10 hr. each), 400 A. of oats.

3. In one day of 10 hr. he plowed  $10\frac{1}{2}$  A. How many acres did he average per hour? How many hours did it take him to plow the 250 A. at the same rate?

4. Find the cost of plowing the 250 A. if it took  $2\frac{1}{2}$  gal. of kerosene per acre at 12¢ a gallon, 1 pt. of oil per acre at 40¢ a gallon, and labor at 30¢ an hour.

5. How long did it take to disk the 500 A. at 38 A. per day of 10 hr.?

6. Find the average number of acres of oats cut per day.

7. What was the average number of bushels of corn shelled per hour, allowing 10 hr. to the day?

8. Find the cost of the kerosene and gasoline used in threshing the 400 A. of oats if 20 gal. of kerosene at 12¢ and  $\frac{1}{2}$  gal. of gasoline @ 22¢ are used in 10 hr.

## Farm Profits

## STATEMENT SHOWING A METHOD OF DETERMINING THE FARM PROFIT

ITEM	APRIL 1, 1918	APRIL 1, 1919
<b>Farm inventory :</b>		
Real estate . . . . .	\$ 13,500.00	\$ 13,500.00
Live stock . . . . .	2,729.00	2,883.00
Machinery and tools . . . . .	475.00	461.00
Feed and supplies . . . . .	658.00	836.00
Bills receivable . . . . .	46.00	
Cash on hand and in bank . . . . .	670.00	2,148.00
<b>Total farm investment . . . . .</b>	(a)	(b)
Bills payable . . . . .	2000.00	1500.00
<b>Net worth each year . . . . .</b>	(c)	(d)
<b>Increase in net worth . . . . .</b>		(e)
<b>Cash account :</b>		
Personal expenses . . . . .	148.00	
Household expenses . . . . .	420.00	
Interest on mortgage of \$ 2000 . . . . .	100.00	
<b>Total money paid out for other than farm expenses during year . . . . .</b>		(f)
<b>Supplies and rent :</b>		
Supplies furnished by farm to owner . . . . .	120 00	
Rent of farmhouse (its value to owner) . . . . .	180.00	
<b>Total supplies and house rent . . . . .</b>		(g)
<b>Total farm gain . . . . .</b>		(h)
<b>Interest and labor :</b>		
Interest on <i>average</i> of total farm investment of (i) at 5 per cent . . . . .	(j)	
Unpaid family labor (estimated) . . . . .	300.00	
Owner's labor (estimated) . . . . .	700.00	
<b>Total interest and labor . . . . .</b>		(k)
<b>Actual farm profit . . . . .</b>		(l)

To determine the actual profit a farm has made during the year, the following accounts are necessary:

(1) Two inventories, one at the beginning, the other at the end of the year.

(2) The totals of the personal and the household expenses during the year.

(3) The interest paid on indebtedness during the year.

(4) The value of the supplies furnished by the farm toward the living of the farmer and his family.

1. Find the total farm investment as shown by the statement on page 288 (*a*) in 1918; (*b*) in 1919; (*c*) the net worth in 1918 (after deducting bills payable); (*d*) the net worth in 1919; (*e*) the increase in net worth exclusive of household and personal goods.

2. What was the total paid out during the year for other than farm expenses (*f*)? the total of supplies and rent (*g*)? the total farm gain (*h*)? [ $(e) + (f) + (g)$ .]

3. What was the average (*i*) of the first and second year's investment, that is, of (*a*) and (*b*)? What was the interest on this average at 5% (*j*)? What was the total of interest and labor (*k*)?

4. The actual farm profit (*l*) was the difference between (*h*) and (*k*). Find this profit.

5. What was the per cent of net profit on (*i*), the total average investment?

6. By what per cent did the live stock increase in value from 1918 to 1919?

7. What per cent of the 1918 value of the real estate was the rent?

8. What was the rate of interest on the mortgage?

9. If the personal and household expenses had been 10% higher, what would have been the total farm gain (*h*)?

## Food Values

The most important ingredients in our food are (1) protein, (2) fats, and (3) carbohydrates. The following table shows the per cent of these food materials in a number of common articles of food and the fuel value per pound measured in calories or units of heat and energy. The proteins are the tissue builders and the carbohydrates (starches and sugars) and the fats furnish heat and energy.

FOOD	PROTEIN %	FAT %	CARBO- HYDRATES %	FUEL VALUE
Sugar . . . . .	0.	0.	100.	1860
Wheat bread . . . . .	9.1	1.6	53.3	1225
Rye bread . . . . .	9.0	.6	53.2	1180
Whole-wheat bread . . . . .	9.7	.9	49.7	1140
Butter . . . . .	1.0	85.0	—	3605
Whole milk . . . . .	3.3	4.0	5.0	325
Ham, fresh, lean . . . . .	25.0	14.4	—	1075
Beefsteak, porterhouse . . . . .	21.9	20.4	—	1270
Mutton . . . . .	18.5	18.	—	1105
Bacon, smoked . . . . .	10.5	64.8	—	2930
Eggs . . . . .	13.4	10.5	—	720
Fowls . . . . .	19.3	16.3	—	1045
Cocoa . . . . .	21.6	28.9	37.7	2320
Rice . . . . .	2.8	.1	24.4	510
Oatmeal . . . . .	16.1	7.2	67.5	1860
Potatoes, Irish . . . . .	2.2	.1	18.4	385
Beans, fresh . . . . .	2.3	.3	7.4	195
Apples . . . . .	.4	.5	14.2	290
Oranges . . . . .	.8	.2	11.6	240

1. Find the amount of carbohydrates in a bag of sugar containing  $3\frac{1}{2}$  lb.

2. How much protein, carbohydrates, and fat does a 12-ounce loaf of wheat bread supply? of rye bread?

3. Find the total amount of protein, carbohydrates, and fat consumed by a boy who ate the following meal:

2 oz. whole-wheat bread	3 oz. potatoes	5 oz. oranges
$\frac{1}{2}$ oz. butter	4 oz. beans	
2 oz. porterhouse steak	5 oz. cocoa	

4. What is the difference in the amount of protein obtained from 1 lb. of ham and 1 lb. of porterhouse steak? the difference in fat? in calories or heat units?

5. If 10 eggs weigh 1 lb., compare the value of the food materials in 1 egg with that in  $2\frac{1}{2}$  oz. of mutton.

6. If a glass of milk weighs 6 oz., how much of each of the food materials does it contain?

7. Compare the amount of food substances in 1 lb. of rye bread and 1 lb. of Irish potatoes.

8. The average growing child requires 2 to  $2\frac{1}{2}$  oz. of protein a day and enough fats and carbohydrates to bring the fuel value up to 2000–3000 calories. Find how the following dietary meets these conditions.

FOOD FOR ONE DAY	PROTEIN Oz.	FAT Oz.	CARBO- HYDRATES Oz.	YIELD IN ENERGY AND HEAT UNITS
<i>Breakfast</i>				
Oranges . . . . .	.04	.01	.58	75.
Rice . . . . .	.11	.001	.96	124.72
Cocoa . . . . .	.11	.33	.19	123.
Dry toast . . . . .	.06	.008	.3	44.4
Butter . . . . .	.05	.43	—	112.5
<i>Lunch</i>				
Bean soup . . . . .	.38	.07	1.	182.8
Lettuce and mayonnaise sand- wiches . . . . .	.44	.48	2.42	428.4
Dates . . . . .	.04	.05	.59	177.6
<i>Dinner</i>				
Cream of celery soup . . .	.11	.34	.17	124.8
Breast of veal . . . . .	.38	.25	—	104.8
Baked potatoes . . . . .	.1	.01	.26	98.1
Green peas . . . . .	.13	.1	.2	103.2
Salad, string bean . . . .	.01	.33	.04	95.7
Bread and butter . . . . .	.22	.48	1.18	275.
Pudding, floating island . .	.15	.05	.55	118.8
Whole milk . . . . .	.19	.24	.3	123.6
<b>Total</b>				

## Choice of Investments

1. Which investment will yield the greater annual income—ten \$100 shares of 7% preferred stock bought at par, a \$1000 mortgage at  $5\frac{1}{2}\%$ , or a \$1000  $4\frac{1}{4}\%$  Liberty bond. List these investments in the order of their safety.

2. Two brothers, John and George, inherited \$10,000 each. John invested his money as follows:

	COST	YEARLY INCOME	REALIZED
100 (\$100) shares mining stock at 20 (1% dividend)	?	?	\$1000
75 (\$100) shares 7% Dry Goods pf. stock at par	?	?	6750
\$500 in a savings bank at 4%	?	?	500

Find in each case the cost and the yearly income.

3. George invested his money as follows:

	COST	YEARLY INCOME	REALIZED
Two \$1000 Liberty Loan bonds at par, $4\frac{1}{4}\%$	?	?	\$2060
A \$5000 1st mortgage on a farm, 5%	?	?	5000
Three \$1000 State bonds at par, 4%	?	?	3090

Find in each case the cost and the yearly income.

4. What per cent of George's income was John's?

5. After three years, the brothers disposed of their investments, realizing the amounts shown in the last columns. Add to these amounts the three years' income on each investment. What per cent of George's total was John's? Which brother in the long run made the better investment?

6. In 1903 Mr. Root bought ten \$100 shares of stock at par. He received a dividend of 6% a year for the first 8 yr. and 3% for the next 7 yr. He sold the stock in 1918 at 70. Find the net income for the 15 yr., after deducting the loss.

7. In 1918 Mr. Root bought a \$1000 bond of the Fourth Liberty Loan yielding  $4\frac{1}{4}\%$  interest and redeemable at par in 15 yr. How much interest will this bond earn in the 15 yr.? By how much is it better than the first investment?



### Cost of the Great War

1. The total war expenses of the leading belligerents to Aug. 1918 were as follows: Find the totals (a) of the Allies; (b) of the Central Powers; (c) of all together:

ALLIES	WAR COST TO AUG. 1918	CENTRAL POWERS	WAR COST TO AUG. 1918
United States . . .	\$ 8,000,000,000	Germany . . . .	\$35,000,000,000
Great Britain . . .	27,000,000,000	Austria-Hungary .	<u>13,000,000,000</u>
France . . . . .	21,500,000,000		
Italy . . . . .	8,500,000,000		
Russia . . . . .	<u>21,000,000,000</u>		

2. What per cent of the total was spent by each country?

3. The national debts of these seven nations before and during the war were as follows. Find (a), (b) the total pre-war and the total war debts of the Allies; (c), (d) of the Central Powers; (e), (f) of all together.

ALLIES	PRE-WAR DEBT	AUG. 1, 1918. NET WAR DEBT
United States . . .	\$ 1,000,000,000	\$ 4,000,000,000
Great Britain . . .	3,500,000,000	20,000,000,000
France . . . . .	6,500,000,000	24,000,000,000
Italy . . . . .	2,800,000,000	7,000,000,000
Russia . . . . .	<u>4,600,000,000</u>	<u>24,000,000,000</u>

CENTRAL POWERS	PRE-WAR DEBT	AUG. 1, 1918. NET WAR DEBT
Germany . . . . .	\$ 1,165,000,000	\$ 35,000,000,000
Austria-Hungary .	<u>3,995,000,000</u>	<u>15,000,000,000</u>

4. What per cent of its pre-war debt was the war debt of each country?

5. What per cent of the total pre-war debt was the total war debt to Aug. 1, 1918?

6. Including loans, our war bill to July, 1919, amounted to \$30,000,000,000. What per cent of this amount was raised by (a) the First Liberty Loan, \$3,035,221,000; (b) Second Liberty Loan, \$4,617,532,000; (c) Third Liberty Loan, \$4,176,517,000; (d) Fourth Liberty Loan, \$6,989,047,000?

## PROBLEMS WITHOUT NUMBERS

1. How can you tell the par value of a given number of shares of stock, when you know the total cost, excluding brokerage?

2. If you consult the newspaper quotations, how can you tell the market value of a given number of shares of stock?

3. How can you find the dividend on a given amount of stock if you know the rate of dividend?

4. What is the difference between stocks and bonds?

5. If you know the newspaper quotation on bonds of a certain series, how can you find the cost of a given number of the bonds? Allowing the usual brokerage, how can you find the proceeds derived from their sales?

6. If you know the par value of bonds of a certain series and the rate of interest, how can you find the income derived from a given number of the bonds?

7. Express as a formula the area of any triangle.

8. How do you find the hypotenuse of a right-angled triangle?

9. Express as a formula the area of a parallelogram; of a trapezoid; of a trapezium.

10. If you know the diameter of a circle, how can you find its radius? its circumference? its area?

11. If you know the three dimensions of a rectangular solid, how can you find its volume?

12. If you know the circumference of a cylinder, the area of the base, and the altitude, tell how you find (a) its convex surface; (b) its entire surface; (c) its volume.

13. How do you find the surface of a pyramid or of a cone if you know the perimeter of its base and its slant height?

14. How do you find the volume of a pyramid or of a cone if you know the area of its base and its altitude?

## TESTS FOR ACCURACY AND SPEED

NOTE. In such exercises the pupils may occasionally "run number races," to see how many correct answers each pupil can get in a given time. Establish a class standard and let each pupil drill until he has reached it.

### Written Work

In adding, group numbers into convenient combinations, such as groups that make 5, 10, 15, etc.

Add and test:

1.	2.	3.	4.
\$ 167.34	\$ 428.99	\$ 175.13	829.945
43.26	160.50	436.18	4752.8502
67.58	47.25	94.83	661.54
987.53	675.83	2378.46	8675.83
49.76	67.24	671.42	672.4005
8.39	654.91	916.45	29.006
557.81	9380.92	112.81	456.1925
748.16	211.18	3819.29	5841.28
62.39	15.47	154.76	75.4103
822.16	357.23	35.72	746.095
721.50	1762.13	6167.31	3284.67
18.52	55.61	834.25	127.05
15.17	438.31	65.87	436.2054
274.38	64.83	749.57	8830.47
135.86	2461.72	938.41	921.11
333.33	315.91	7184.67	5342.3908
666.66	7053.09	8765.43	9753.0021
900.09	6205.60	6543.21	8040.3009
<hr/>	<hr/>	<hr/>	<hr/>

Subtract and test :

5. $9,500,832$ <u>$5,362,834$</u>	8. $\$28,050.72$ <u>$8,493.84$</u>	11. $3684.021$ <u>$986.518$</u>
6. $8,029,533$ <u>$4,960,873$</u>	9. $\$95,586.36$ <u>$39,679.85$</u>	12. $270.5421$ <u>$64.7423$</u>
7. $9,780,632$ <u>$5,928,058$</u>	10. $\$79,002.31$ <u>$57,220.90$</u>	13. $9700.05$ <u>$6090.99$</u>

Multiply and test :

14. $8984$ <u>$2169$</u>	17. $\$80.56$ <u>$6907$</u>	20. $\$40.56$ <u>$870.5$</u>	23. $89.56$ <u>$954.7$</u>
15. $7564$ <u>$6034$</u>	18. $\$76.50$ <u>$4053$</u>	21. $\$39.42$ <u>$563.5$</u>	24. $652.8$ <u>$4.436$</u>
16. $9524$ <u>$8069$</u>	19. $\$35.42$ <u>$7009$</u>	22. $\$26.80$ <u>$80.35$</u>	25. $5.986$ <u>$96.08$</u>

Find the quotients and test :

26. $43,160,340 \div 862$	34. $54,048.85 \div 989$
27. $2,447,592 \div 714$	35. $443,386.08 \div 489$
28. $\$92,686.38 \div 534$	36. $8.399 \div 3.7$
29. $\$77,846.46 \div 509$	37. $33.656 \div .056$
30. $\$627,521.20 \div 890$	38. $.308 \div 14$
31. $58,452.542 \div 857$	39. $25.8741 \div .777$
32. $84,546.6 \div 678$	40. $.5 \div 125$
33. $227,842.66 \div 586$	41. $450 \div .15$

First add ; then subtract :

42. $569\frac{2}{3}$ <u>$483\frac{5}{8}$</u>	43. $780\frac{3}{10}$ <u>$249\frac{4}{5}$</u>	44. $1000\frac{5}{16}$ <u>$299\frac{5}{8}$</u>	45. $1684\frac{1}{5}$ <u>$921\frac{1}{20}$</u>
------------------------------------------------------------	-------------------------------------------------------------	--------------------------------------------------------------	--------------------------------------------------------------

First multiply; then divide:

46.  $13\frac{5}{8}$  by  $2\frac{3}{4}$       48.  $25\frac{3}{8}$  by  $6\frac{5}{8}$       50.  $34\frac{3}{16}$  by  $4\frac{1}{4}$   
 47.  $15\frac{1}{2}$  by  $5\frac{3}{8}$       49.  $50\frac{5}{8}$  by  $10\frac{1}{2}$       51.  $5\frac{3}{10}$  by  $5\frac{3}{5}$

Find:

52.  $87\frac{1}{2}\%$  of 8160      54. 47 % of \$25.50  
 53.  $66\frac{2}{3}\%$  of 6000      55. 125 % of \$30.75

Find what per cent the first number is of the second:

56. 25 of 200      58. 33 of 99      60. 100 of  $33\frac{1}{3}$   
 57. 18 of 640      59. \$12 of \$200      61. 100 of  $62\frac{1}{2}$

Find the profit or loss:

COST	RATE OF GAIN	COST	RATE OF LOSS
62. \$350.25	20 %	64. \$6450	$33\frac{1}{3}\%$
63. \$405.56	25 %	65. \$7494	$16\frac{2}{3}\%$

Find the per cent of profit or loss:

COST	SELLING PRICE	COST	SELLING PRICE
66. \$15	\$25	68. \$250	\$200
67. \$18	\$21	69. \$500	\$400

Find the discount and the net price:

LIST PRICE	RATE OF DISC.	LIST PRICE	RATES OF DISC.
70. \$12.75	40 %	72. \$1000	25 %, 10 %
71. \$16.80	$87\frac{1}{2}\%$	73. \$3000	40 %, 5 %

Find the interest and the amount:

PRIN.	RATE	TIME	PRIN.	RATE	TIME
74. \$5000	6 %	$3\frac{1}{2}$ yr.	76. \$3500	$5\frac{1}{2}\%$	$2\frac{1}{2}$ yr.
75. \$6324	5 %	$4\frac{1}{4}$ yr.	77. \$4500	$4\frac{1}{2}\%$	$3\frac{1}{8}$ yr.

Find the date of maturity, the term of discount, the bank discount, and the proceeds of the following notes:

FACE	TIME	DATE OF NOTE	DATE OF DISCOUNT	RATE OF DISCOUNT
78. \$5500	4 mo.	April 1	May 1	5 %
79. \$6400	60 da.	Nov. 1	Dec. 1	6 %

Find the cost of the following stock, brokerage \$.15 a share.

	NO. OF SHARES	MARKET PRICE		NO. OF SHARES	MARKET PRICE
80.	200	54 $\frac{1}{4}$	82.	50	98 $\frac{3}{8}$
81.	500	105 $\frac{1}{2}$	83.	10	100 $\frac{1}{2}$

How much is received from the sale of the following stock, brokerage \$.15 a share?

	NO. OF SHARES	MARKET PRICE		NO. OF SHARES	MARKET PRICE
84.	100	75 $\frac{7}{8}$	86.	50	100 $\frac{1}{2}$
85.	75	112 $\frac{1}{4}$	87.	200	93 $\frac{1}{8}$

Find the cost of the following bonds, par value \$1000 (brokerage  $\frac{1}{8}$  % of par value); also the interest on them:

	NO. OF BONDS	MARKET PRICE	RATE		NO. OF BONDS	MARKET PRICE	RATE
88.	5	101 $\frac{1}{8}$	5 $\frac{1}{2}$ %	90.	10	84 $\frac{3}{8}$	4 %
89.	1	90 $\frac{1}{2}$	4 $\frac{1}{2}$ %	91.	2	97	5 %

Find the circumferences of the following circles:

92. Diameter 10 in.	94. Radius 4 $\frac{1}{2}$ ft.
93. Diameter 25 ft.	95. Radius 10 $\frac{1}{2}$ ft.

Find the areas of the following figures:

96. Triangle—base 25 in., alt. 4 in.	99. Circle—radius 25 in.
97. Rhomboid—base 20 ft., alt. 16 ft.	
98. Circle—diam. 16 ft.	

Find the volumes of the following figures:

100. Prism or cylinder—base 225 sq. in., alt. 10 in.
101. Pyramid or cone—base 450 sq. in., alt. 15 in.

Find the square root of:

102. 529	104. 6889	106. 10,404
103. 841	105. 9216	107. 12,769

## GENERAL REVIEW

### Oral Work

1. An airplane flew 90 mi. in 50 min. How many miles per minute did it fly? How many minutes did it take to fly one mile?

2. Each member of Mr. Rand's family used  $1\frac{3}{8}$  oz. of sugar a day. How many small lumps were used by each person, counting 5 lumps to the ounce? How many teaspoonfuls, allowing 6 teaspoonfuls to the ounce?

3. If  $1\frac{3}{8}$  oz. of sugar were used each day by each member, how many pounds were used in a month of 30 days by 5 members?

4. One hundred years ago each person consumed an average of 9 lb. of sugar a year. What per cent was this of the use of 3 lb. a month?

5. If each person in a family of 8 consumed  $\frac{1}{2}$  oz. of butter a day, in how many days did the family use 1 lb.?

6. A man ate 18 lb. of fish a year (360 da.). What part of a pound was this per day?

7. A family with an income of \$2000 a year spent 20 % for rent, 30 % for food, and 15 % for clothing. How much was spent for each item?

8. John had 12 hens that laid 960 eggs in a certain time. What was the average number of eggs per hen?

9. What per cent was saved by buying 3 lb. of potatoes for 10¢ instead of at 4¢ a pound?

10. Ratification by 36 out of 48 states was necessary for the adoption of the prohibition amendment. What part of all the states had to ratify this measure before it was adopted?

11. When a  $3\frac{1}{2}$ -pound bag of flour cost 21¢, how much, at the same rate, did a  $24\frac{1}{2}$ -pound bag cost?

SUGGESTION. How many times  $3\frac{1}{2}$  lb. is  $24\frac{1}{2}$  lb.?

12. A corn club champion raised 100 bu. of corn on an acre of ground at a cost of \$20. What was the cost per bushel? He sold the corn at \$1.20 a bushel. What was his total profit?

13. Choose any number; multiply it by 6; add 12; divide by 6; subtract the original number. How do I know that your answer is 2?

14. Choose another number; multiply it by 10; subtract 5; divide by 5; add 1. How do I know that your answer is twice the original number?

15. Henry borrowed \$500 to help him through college. How much annual interest did he pay on it at 5%?

16. If a man's salary was \$2400, and he saved  $37\frac{1}{2}\%$  of it each year, how much did he save in 3 years?

17. A discount of 30% and 10% equals what single discount?

18. Find the cost of  $3\frac{5}{8}$  yd. of ribbon at 24¢ a yard.

19. Mrs. Hart bought a sewing machine for \$75. She paid \$15 down and the rest at the rate of \$2 a week. In how many weeks did she pay for the machine?

20. Find the semiannual interest, at 4% a year, on a \$100 Liberty bond of the second issue.

21. Find the volume of a cube having a surface of 96 sq. in.

22. A house cost \$6000. It rented for \$360 a year. The expenses were 2% of the cost. What was the net income?

23. How much interest did George pay on \$1000 borrowed for 2 yr. and 3 mo. at 6%?

24. How many yards of gingham, at  $37\frac{1}{2}$ ¢ a yard, could be bought for \$3?



## Written Work

1. Which is cheaper, and how much, to buy a bushel of potatoes (60 lb.) for \$1.75, or to buy the same quantity at the rate of 5 lb. for \$.13?

2. Which is cheaper, and how much,  $3\frac{1}{2}$  lb. of flour for 25¢, or  $24\frac{1}{2}$  lb. for \$1.45?

3. When  $3\frac{1}{2}$  lb. of sugar cost 34¢ find, at the same rate, the cost of a bag containing 100 lb.

4. The United States corn crop in 1917 was 3,100,000,000 bu. and in 1918 it was 2,700,000,000 bu. How much less was it in 1918 than in 1917?

5. American army aviators in the United States flew a distance of 30,000,000 mi. in a week. How many times the distance around the equator (25,000 mi.) was this?

6. In a city department, employees with a common school education earned on an average \$1000 a year, those with a high school education  $\frac{4}{5}$  more, and those with a college or technical education  $\frac{2}{5}$  more than the high school graduates. Find the yearly salary of each class.

7. For 5¢ I could buy a package of waxed paper 36 ft. long and 12 in. wide or a package containing 24 sheets 12 in.  $\times$  15 in. Which package contained more paper and how many square feet more?

8. The daily pay of a workman was \$6. If he worked 310 days in a year, and spent on an average \$85 a month, how much had he left at the end of the year?

9. An airplane covered 550 mi. in 4 hr. 10 min. Find its rate per hour.

10. A man with an income of \$2000 a year spent  $\frac{3}{10}$  of it for food,  $\frac{1}{5}$  for rent, and  $\frac{3}{20}$  for clothing. How much did he spend for each of these items?

Find how much more of each commodity was produced in the United States in 1918 than the average for the three years before the war.

	8-YEAR PRE-WAR AVERAGE	1918
11. Beef, pounds . . .	186,400,000	505,400,000
12. Pork, pounds . . .	996,200,000	1,691,400,000
13. Dairy products, pounds	26,600,000	590,800,000
14. Sugar, pounds . . .	621,700,000	2,149,800,000

15. At an average of 75 mi. an hour, how long does it take an airship to cover 5700 mi.?

16. A plowman by measurement finds that he has plowed a strip 4 rd. in width around a rectangular field 20 rd. wide and 40 rd. long. How many acres has he plowed?

17. There are 50 persons in a schoolroom 30 ft. wide, 36 ft. long, and 15 ft. high. How many cubic feet of air space are there for each person? The minimum of fresh air should be 30 cu. ft. per minute per person. How frequently must the room be filled with air to meet this requirement?

18. An oil stove holding  $2\frac{3}{4}$  qt. of oil is filled from a can containing 2 gal. 3 qt. of oil. How many times can it be filled?

19. A rectangular bin 6 ft. wide, 10 ft. high, and 20 ft. long is  $\frac{2}{3}$  filled with grain. How many bushels of grain are there, considering 1 bu. as equal to  $1\frac{1}{4}$  cu. ft.?

20. A coal bin is 12 ft. long, 5 ft. 6 in. wide, and 6 ft. deep. Allowing 35 cu. ft. for a ton of hard coal, how much does it cost to fill the bin at \$9.50 a ton?

21. A train runs 361 mi. in  $9\frac{1}{2}$  hr. What is its average rate per hour?

22. How many cubic yards of broken stone are required to build a road 16 ft. wide, 8 in. deep, and 1 mi. long?

23. Make out sales slips for the following :  $5\frac{3}{4}$  yd. serge @ \$2,  $3\frac{1}{2}$  yd. silk @ \$1.85,  $3\frac{1}{4}$  yd. lining @ \$.20. Amount received, \$20.

24.  $2\frac{1}{2}$  lb. cheese @ \$.36,  $3\frac{1}{2}$  lb. butter @ \$.52,  $2\frac{1}{4}$  doz. eggs @ \$.47. Amount received, \$5.

25. How many cakes of soap 4 in. long, 2 in. wide, and  $1\frac{1}{2}$  in. thick can be packed in a box 2 ft. long, 1 ft. wide, and 1 ft. deep ?

26. Ten pounds of potatoes contain 7.83 lb. of water and 2.17 lb. of solid matter. How much water and solid matter does a bushel of 60 lb. contain ?

27. How many building lots, each 75 ft. by 125 ft., can be laid out in 2 A. 92 sq. rd. 37 sq. yd., and how much are they worth at \$350 a lot ?

28. A steel ingot is 16 in. square and 8 ft. long. What length of steel bar will it make 4 in. thick and 6 in. wide ?

29. It costs \$560 to fence a field 60 rd. wide and 80 rd. long. How much less will it cost to fence a field 50 rd. square with the same kind of fence ?

30. How much does a block of stone weigh which is 6 ft. long, 3 ft. 6 in. wide, 4 ft. 4 in. high, if each cubic foot weighs 180 lb. ?

31. How many cubic yards of gravel are needed to cover a wall 3 ft. wide and 120 yd. long with gravel to a depth of 4 in. ?

32. The perimeter of a square field is 320 rd. How many acres does it contain ?

33. A wire fence for a rectangular field 15 rd. 4 yd. by 40 rd. 3 yd. has three wires. Find the total length of wire in feet.

34. A cow is tied in the corner of a square field by a rope 2 rd. long. Find the extent of the surface over which it can graze.

35. In an examination, 150 questions are asked each of 5 pupils. The first answers 140; the second, 135; the third and fourth, 120 each; and the fifth, 110. Find the average per cent of these five pupils.

36. The window area of a schoolroom should be 20% of the floor area. What should be the window area of a room 31 ft. 6 in. by 28 ft.?

37. If 60% of a farm containing 40 A. 120 sq. rd. is under cultivation, and 25% of the remainder is woodland, how large is the woodland?

38. A house worth \$6000 is rented for \$500 a year. The taxes are \$80; the repairs, \$70; and other expenses, \$24. What per cent does the owner get on his investment?

39. A commission merchant sells 240 bbl. of apples at \$5.50 a barrel, charging 3% commission. If the freight charges are \$60, and cartage charges, \$20, how much does the owner receive?

40. A collector is employed to collect debts amounting to \$1250, his charge being 5%. He is successful in collecting 82% of the debts. What is his commission?

41. What is the cost of a bill of goods listed at \$650 with discounts of 40% and 5%; freight \$5.60?

42. Mr. Brown owns a house worth \$7200, assessed at  $\frac{3}{4}$  of its value. What is his tax at 15 mills on the dollar?

43. What per cent of the value of his house is his tax?

44. A street 40 ft. wide and 40 rd. long is to be graded down on an average  $1\frac{1}{2}$  ft. How much will the excavating cost at 27¢ a cubic yard?

45. How many gallons of water will the tank of a sprinkling wagon hold, if it is 8 ft. long and  $3\frac{1}{2}$  ft. in diameter? (Use 1 cu. ft. =  $7\frac{1}{2}$  gal.)

46. The Federal Food Board issued the following table comparing the prices of the various products for a Thanksgiving dinner. Find the total cost of each dinner and the per cent of increase (to the nearest tenth per cent) of the total from 1913 to 1917; from 1917 to 1918.

	1913	1917	1918
Turkey . . . . .	\$2.24	\$3.60	\$4.00
Stuffing . . . . .	.04	.06	.065
Gravy . . . . .	.128	.188	.23
Candied sweet potatoes . .	.11	.145	.198
Onions . . . . .	.058	.078	.115
Cranberry sauce . . . . .	.13	.235	.243
Cabbage and pepper salad .	.10	.135	.175
Pumpkin pie . . . . .	.13	.196	.23
Candy . . . . .	.36	.48	.74
Nuts . . . . .	.595	.705	.81
Coffee . . . . .	.033	.033	.035
Total cost . . . . .	<u>          </u>	<u>          </u>	<u>          </u>

47. Mr. White's farm is valued at \$18,000. He pays  $4\frac{2}{10}$  mills taxes on an 80% valuation of it. Find his tax.

48. An agent buys 30 tons of manure at \$2 a hundred, 20% and 10% off. Terms: 30 days net, or 2% off for cash. If he pays cash, find the cost.

49. A man pays \$5000 for a house. For enlarging and repairing it he spends 40% of this sum. He then sells it for \$7840. What per cent does he make?

50. A line 28 inches long is divided into two parts, one of which is 3 times as long as the other. How long is each part?

51. What is the amount of \$1575 for 3 yr. 6 mo. at 6%?

52. A man buys an automobile for \$1500. He pays for it by mortgaging his house for \$1500, paying interest at  $5\frac{1}{2}$ %. At the end of two years he sells his automobile for \$700. Not counting the running expenses, what has been the cost per year of his machine?

53. Which is the better offer, a piano listed at \$500, with discounts of 20 %, 10 %, and 5 %, or one listed at the same price with discounts of 5 %, 10 %, and 20 % ?

54. A salesman is offered a choice of a salary of \$3000, or \$2000 with 5 % commission on sales. If he accepts the latter offer and sells \$100,000 worth of goods a year, how much does he profit by his choice ?

55. A piece of steel in the form of a cylinder is 4 ft. long and 2 in. in diameter. How long is it when rolled into a bar 1 in. square ?

56. A bankrupt's liabilities are \$15,000 and his assets are \$9000. How much does a creditor receive whose claim is \$6000, no allowance being made for court costs ?

57. The tax rate in a town is 14 mills on a dollar. What is the tax on property worth \$250,000 ?

58. I buy land at \$62.50 an acre and sell it at 20 % profit, thereby making \$8100. How many acres do I buy ?

59. A man has a life insurance policy for \$5000 on which he pays an annual premium of \$28.40 per thousand. How much does he pay in premiums in 5 yr. ?

60. If the tax rate is \$.75 on \$100, what is the tax on property valued at \$4800, assessed at  $\frac{4}{5}$  of its value ?

61. Sound travels 1120 feet per second. The thunder from a flash of lightning is heard 11 seconds after the flash is seen. How many miles distant is the cloud ?

62. Hats costing \$33 a dozen are sold for \$3.50 each. What is the per cent of profit on each hat ?

63. A barn valued at \$1800 is insured for  $\frac{3}{4}$  of its value, at  $1\frac{1}{2}$  %, for a term of 3 years. Find the average annual cost of insurance.

64. \$200 was borrowed at 5 % on Oct. 1, 1918, and was paid 9 mo. later. What was the amount paid at that time ?

Find the per cent of increase over pre-war wages for the following officers and crew of a tugboat.

	PRE-WAR WAGE	INCREASED WAGE		PRE-WAR WAGE	INCREASED WAGE
65. Captain	\$1680	\$2280	68. Deckhand	\$714	\$1008
66. Licensed Mate	996	1320	69. Cook	708	996
67. Engineer	1524	2160	70. Fireman	744	1020
			71. Oiler	792	1056

72. A 60-day note for \$1000 is discounted at a bank at 6% on the day of issue. Find the proceeds.

73. A man buys an apartment house containing 8 apartments for \$35,000. His taxes, repairs, and insurance cost him \$1157 annually. He rents 4 apartments at \$40 a month, 2 apartments at \$35 a month, and 2 apartments at \$28 a month. What per cent does he realize on his investment?

74. A furniture dealer buys 120 tables @ \$5.50 and gives in payment a 90-day note dated April 21, 1919. If the note is discounted May 3, at 6%, what are the proceeds?

75. The Rose and Ward Company import from England 10 cases of woolen dress goods, invoiced at \$2000 a case. Find the duty at 35% ad valorem.

76. The duty on cigars is \$4.50 a pound and 25% ad valorem. Find the duty on 1000 one-pound boxes of cigars invoiced at \$6 a box.

77. A watch marked \$80 is sold at a discount of 25% and 5% for cash. Find the cash selling price.

78. I have a rectangular field, the perimeter of which is 240 rd. It is twice as long as it is wide. How many acres does it contain?

79. A 90-day note for \$640, without interest, is discounted at the bank at 6% on the day of issue. Find the proceeds of the note.

80. Of the entire army of 2,080,000 men taken abroad,  $46\frac{1}{4}\%$  were carried in American ships and  $48\frac{1}{2}\%$  in British ships. Find how many men were carried in American ships; in British ships; in other ships.

81. On a bill of \$450 two successive discounts of 20 % and 15 % were given. What was the amount of the discount?

82. A broker paid \$6307.50 for stocks at  $105\frac{1}{8}$ . How many shares did he buy?

83. At  $4\frac{1}{2}\%$ , what was the interest on \$750 from Jan. 12, 1915, to July 9, 1919?

84. A wholesale merchant imported from Belgium 30,000 yd. of Brussels carpet at \$1.50 a yard. The duty was 25 % ad valorem. Find the cost in the United States, including the duty.

85. I bought 50 shares of railroad stock at  $156\frac{1}{4}$  and sold it at  $166\frac{3}{4}$ . Find my gain, disregarding brokerage.

86. The residence of Mr. Daniels, valued at \$8000, was insured for 3 years at 90 ¢ per \$100 on 80 % of its valuation. How much premium was paid?

87. Each of two farmers had a ten-acre field of potatoes. One farmer sprayed to prevent blight, using on each acre 200 gal. of mixture costing 30 ¢ a gallon. His yield was 210 bu. an acre. The other neglected to spray his field and produced only 135 bu. an acre. If the potatoes were sold at \$1.85 a bushel, what was the profit due to spraying?

88. A train running 30 mi. an hour was 54 min. in going from one city to another. If it made 3 stops of 4 min. each, how far apart were the cities?

89. The wholesale list price of a stove was \$40, and the retail dealer was allowed 20 %, 10 %, and 5 % off. What price did he pay for the stove?



90. The cotton produced in the United States in 1918 amounted to 11,800,000 bales. This represented an increase of 500,000 bales over the 1917 crop and an increase of 350,000 bales over the 1916 crop. Find, to the nearest tenth per cent, the per cent of increase in each case.

91. A farm roller 8 ft. long and  $2\frac{1}{2}$  ft. in diameter will pass over how much surface in 100 revolutions?

92. A debt of \$450 was paid at the expiration of 2 yr. 4 mo. The rate of interest being 5%, what was the amount paid?

93. The face of one side of a cube is a surface of 100 sq. ft. Find the volume of the cube.

94. A man bought a house and lot for \$3500; he paid \$1000 cash and gave a mortgage for the balance at 6%. At the end of 9 mo. he sold the house and lot for \$4500, paying the interest due on the mortgage at the time of sale. How much did he realize on his investment?

95. Find the amount of a note for \$550 at 6%, given Dec. 1, 1916, and paid May 15, 1919.

96. On a bill of goods amounting to \$900, I was offered a discount of 25%, or two successive discounts of 15% and 10%. Which was more advantageous for me to accept, and how much more?

97. My gas meter registered 11,800 cu. ft. on Jan. 1, and 35,800 cu. ft. on Feb. 1. I received a cash discount of 2¢ on the even thousand cubic feet. At 27¢ a thousand cubic feet, how much did I pay for the gas used in January?

98. I imported from Canada 7500 yd. of flannel valued at \$1.25 a yard, ad valorem duty 30%. Find the amount of duty paid.

99. The United States wheat crop in 1917 was 651,000,000 bu. and in 1918, 41.16 % more. What was the wheat crop of 1918?

100. The corn yield of 2,700,000,000 bu. in 1918 was what per cent less than the yield of 3,100,000,000 bu. in 1917?

101. The cotton crop increased from 11,300,000 bales in 1917 to 4.425 % more in 1918. What was the crop of 1918?

102. A boy bought a newspaper route for \$75. He paid \$10 down, and agreed to pay the balance in weekly payments by using  $\frac{1}{2}$  of his profits. If he averaged 250 customers and made 4¢ a week on each customer, how many weeks did it require to pay the debt?

103. A street  $\frac{1}{2}$  mi. long and 60 ft. wide was paved with granite blocks and curbed on both sides. The paving cost \$2.75 a square yard and the curbing, 60¢ a lineal foot. Find the entire cost.

104. A man paid \$8000 for a house and lot. If taxes were \$85 and other expenses \$35 a year, what monthly rent must he get for it to make 6% on the cost of the property?

105. A town expended for improvements \$6894. The assessed valuation was \$480,000. Find the rate levied to cover the expense, including the collector's commission estimated at \$306.

106. A swimming pool was 40 ft. wide, 90 ft. long, and averaged 5 ft. in depth. How many gallons of water did it contain when full? (Use 1 cu. ft. =  $7\frac{1}{2}$  gal.)

107. A dealer bought 4 loads of hay at \$22.50 a ton. The loads, including the wagons, weighed 4456 lb., 3920 lb., 4330 lb., and 4260 lb. The wagons averaged 1180 lb. in weight. Find the value of the hay.

**108.** Our foreign trade in 1915 amounted to \$4,442,000,000; in 1916, to \$6,531,000,000; in 1917, to \$8,949,000,000, and in 1918, to \$8,874,000,000. Find the per cent of increase or decrease each year from the year preceding. Draw a graph to represent the foreign trade for these years.

**109.** One year the mineral production of the United States was valued at \$5,010,948,000, which was an increase of 43% over the preceding year. Find, to the nearest cent, the valuation for the preceding year.

**110.** A rectangular field, whose width was  $\frac{1}{2}$  of its length, had a perimeter of 600 rd. What was the length of each side?

**111.** Find the interest on \$427 for 2 yr. 6 mo. 21 da. at 4%.

**112.** Stock was bought at  $85\frac{1}{8}$  and sold at  $109\frac{7}{8}$ . What was the profit on 130 shares, brokerage \$.15 a share?

**113.** From one tenth take one thousandth; multiply the remainder by ten thousand; divide the product by one million; and write the answer in words.

**114.** A drugget 12 ft. by 15 ft. covered  $\frac{3}{5}$  of the floor of a room 15 ft. wide. Find the length of the room.

**115.** A rectangular farm was 24 rd.  $\times$  80 rd.  $16\frac{2}{3}\%$  was planted with potatoes,  $33\frac{1}{3}\%$  with corn, and the remainder was in pasture. How many acres were there in each part?

**116.** The total assessed valuation of a school district in a certain state was \$3,009,251. The amount to be raised for state and county taxes was \$17,886.41 and for local tax, \$34,601.84. Find the rate of taxation to tenths of a mill.

**117.** The oxygen in the air is to the nitrogen as 21 to 79. Find the number of cubic feet of each gas in a schoolroom whose inside dimensions are 24 ft.  $\times$  30 ft.  $\times$   $12\frac{1}{2}$  ft.

Find, to the nearest tenth per cent, the per cent of discount allowed on each of the following articles at a bargain sale :

SHEETS		REG.	SALE	PILLOWCASES		REG.	SALE
118.	54" × 90"	\$1.69	\$1.55	122.	42" × 36"	\$ .50	\$ .43
119.	63" × 90"	1.89	1.62	123.	42" × 38½"	.55	.45
120.	72" × 99"	2.25	1.82	124.	50" × 38½"	.65	.55
121.	90" × 108"	2.85	2.49	125.	54" × 38½"	.90	.80
BATHROOM MATS		REG.	SALE	BRAIDED RUGS		REG.	SALE
126.	24" × 36"	3.50	2.75	130.	26" × 36"	6.50	5.50
127.	27" × 54"	5.50	4.25	131.	36" × 57"	16.00	13.50
128.	24" × 60"	6.75	5.25	132.	48" × 84"	31.50	27.00
129.	30" × 60"	7.25	5.75	133.	60" × 101"	50.00	43.00

134. At a sale of rugs Mrs. Root bought the following : one Chinese rug \$45, discount 10% ; one Persian rug \$165, discount 15% ; and one Turkish rug \$225, discount 25%. Find her total bill.

135. A farmer's herd of 15 cows averaged 24 lb. of milk per head daily. The milk contained 3.5 % butter fat, which was worth 25 ¢ a pound. How much did the farmer receive for his milk in a month of 30 da.?

136. An agent sold 1700 bbl. of apples at \$3.50 a barrel. He paid \$112 for freight, \$14.25 for cartage, and \$12.75 for storage. After deducting his commission, he sent the owner \$4026. What was the rate of commission?

137. Ames Brothers, brokers, bought for me 10 shares of United Produce, selling at 129½, par value \$100. Find the total cost of the stock, including brokerage at \$.20 a share.

138. A house that had been insured for \$3000 at 1¼ % for each term of 3 years was destroyed by fire in the ninth year. How much did the money received exceed the premiums paid?

From the following table find, to the nearest tenth per cent, the increase or decrease in the price of each article :

	ARTICLE	LAST YEAR	THIS YEAR	PER CENT OF INCREASE	PER CENT OF DECREASE
139.	Apples, per barrel	\$2.50	\$3.00		
140.	Beans, per 100 lb.	15.75	12.00		
141.	Butter, per pound	.49½	.69		
142.	Cabbage, per barrel	1.40	1.25		
143.	Cheese, per pound	.24½	.37		
144.	Codfish, per 100 lb.	9.25	11.00		
145.	Cornmeal, per pound	.059	.067		
146.	Eggs, per dozen	.66	.75		
147.	Ham, per pound	.396	.48		
148.	Onions, per bag	2.00	1.75		
149.	Potatoes, per 100 lb.	2.55	2.25		
150.	Rice, per pound	.08½	.10½		
151.	Sugar, per 100 lb.	8.35	9.00		

152. A natural gas company declared a semiannual dividend of 4 % on a capital stock of \$150,000. Find the yearly dividend of a stockholder who owns 36 shares, par value \$50 a share.

153. A clerk made the following deposits in a savings bank, at 4 % interest, payable January 1 and July 1 : January 2, 1917, \$500 ; July 1, 1917, \$350 ; July 1, 1918, \$200. On January 2, 1918, he drew out \$100. What was his balance July 1, 1919?

154. A commission merchant sold 60 lb. of butter for \$31.20. His commission was 5 %. How much per pound did the shipper receive for his butter?

155. Mr. Adams bought a property for \$20,000. He expended \$4000 in improvements. The repairs each year averaged \$250, the insurance and taxes \$400. For how much a year must he rent the property to realize 6 % net on his investment?

## SUPPLEMENT

**NOTE.** The following methods of finding the greatest common divisor and the least common multiple, which were purposely omitted from the body of the book, are here presented for the convenience of teachers who think it desirable to teach them. The word "number" as referred to on pp. 314 and 315 means "integral number."

### GREATEST COMMON DIVISOR

A number that exactly divides each of several numbers is called a **common divisor**. Thus, 4 is a common divisor of 16 and 24.

The greatest number that exactly divides each of several numbers is called their **greatest common divisor (g. c. d.)**. Thus, 9 is the g. c. d. of 27 and 36.

A number that has no factors except itself and 1 is called a **prime number**.

A factor that is a prime number is called a **prime factor**.

### Written Work

1. Find the greatest common divisor of 56, 98, 154.

$56 = 2 \times 2 \times 2 \times 7$   
 $98 = 2 \times 7 \times 7$   
 $154 = 2 \times 7 \times 11$   
**g. c. d. =  $2 \times 7$ , or 14**

*As the g. c. d. of two or more numbers is the product of all their common prime factors, resolve each number into its prime factors and find which factors are common to all the numbers. 2 and 7 are all the common prime factors of the numbers. Hence, the g. c. d. of 56, 98, and 154 is  $2 \times 7$ , or 14.*

Find the g. c. d. of:

- |                 |                 |                 |
|-----------------|-----------------|-----------------|
| 2. 42, 63, 189  | 4. 48, 60, 96   | 6. 84, 56, 210  |
| 3. 54, 216, 360 | 5. 84, 252, 512 | 7. 22, 110, 132 |

## LEAST COMMON MULTIPLE

A number that is exactly divisible by each of several numbers is called a **common multiple**. Thus, 36 is a common multiple of 6 and 9.

The least number that is exactly divisible by each of several numbers is called their **least common multiple (l. c. m.)**. Thus, 18 is the l. c. m. of 6 and 9.

### Written Work

1. Find the l. c. m. of 18, 32, and 40.

$$18 = 2 \times 3 \times 3$$

$$32 = 2 \times 2 \times 2 \times 2 \times 2$$

$$40 = 2 \times 2 \times 2 \times 5$$

*The l. c. m. of two or more numbers is the product of all their prime factors, each factor being used as often as it occurs in any number.*

$$\text{l. c. m.} = 2^5 \times 3^2 \times 5, \text{ or } 1440.$$

2 occurs 5 times as a factor in 32.

It must, therefore, be used 5 times in the l. c. m. 3 occurs twice as a factor in 18; it must, therefore, be used twice in the l. c. m. 5 occurs once as a factor in 40; it must, therefore, be used once in the l. c. m. Hence, the l. c. m. of 18, 32, and 40 is  $2^5 \times 3^2 \times 5 = 1440$ .

2. Find the l. c. m. of 12, 36, 54, and 63.

$$\begin{array}{r} 2 \overline{) 12 \quad 36 \quad 54 \quad 63} \\ \underline{3 \overline{) 18 \quad 27 \quad 63}} \\ \underline{3 \overline{) 6 \quad 9 \quad 21}} \\ \underline{2 \quad 3 \quad 7} \end{array}$$

Since 12 is a divisor of 36, the l. c. m. of 36, 54, and 63 is also a multiple of 12. 12 may therefore be rejected from the work.

$$\text{l. c. m.} = 2^2 \times 3^3 \times 7 = 756.$$

Divide any two of the numbers by a common prime factor. Then divide the quotients in like manner until the quotients are prime to each other. The product of the divisors and the last quotients is the l. c. m.

Find the l. c. m. of :

3. 24, 48, 72

7. 30, 60, 105

11. 144, 180, 240

4. 36, 70, 105

8. 32, 48, 96

12. 85, 51, 255

5. 32, 40, 48

9. 45, 70, 90

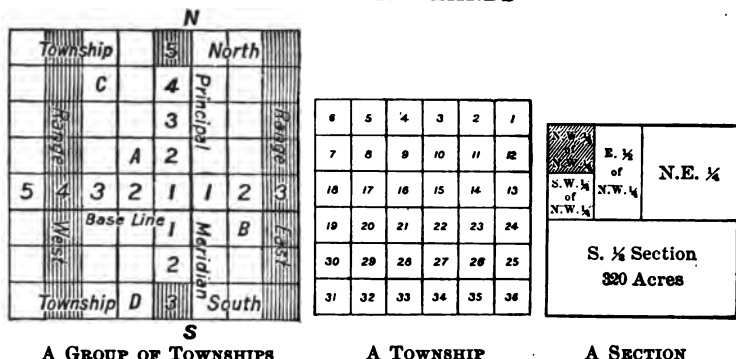
13. 120, 225, 540

6. 25, 35, 56

10. 48, 64, 72

14. 98, 42, 126

## GOVERNMENT LANDS



The public lands of the United States are surveyed by selecting a north and south line, called a **principal meridian**, and intersecting this by an east and west line, called a **base line**.

**Range lines** are lines running north and south on each side of the principal meridian, at distances of 6 miles. They divide the land into strips 6 miles wide, called **ranges**.

East and west lines parallel to the base line, and at distances of 6 miles, divide the ranges into **townships**. A range is, therefore, a row of townships running north and south.

The *townships* in each range are numbered north and south from the base line, and the *ranges* are numbered east and west from the principal meridian. A township is designated by its number and direction from the base line, the number and position of its range, and the name or number of the principal meridian. Thus, Township A is 2 North, Range 2 West of Principal Meridian. What is the designation of township B? C? D? A township is 6 miles square and is divided into 36 sections each one mile square. Each section contains 640 acres.

W.  $\frac{1}{4}$  Sec. 31, T. 22 N., 4 E. 3d P. M. is read "West  $\frac{1}{4}$  section 31, township 22 North, Range 4 east of third principal meridian."

1. Read: S.  $\frac{1}{2}$  of S.E.  $\frac{1}{4}$ , Sec. 31; N.W.  $\frac{1}{4}$  of S.E.  $\frac{1}{4}$ , Sec. 31.

2. Locate S.W.  $\frac{1}{4}$ , Sec. 5, T. 4 S., R. 3 W.

3. Locate S.  $\frac{1}{2}$  of N.E.  $\frac{1}{4}$ , Sec. 4, T. 15 N., R. 5 E.



## SIMPLE INTEREST TABLE (6%)

YEARS	\$1000	\$2000	\$3000	\$4000	\$5000	\$6000	\$7000	\$8000	\$9000
1	60	120	180	240	300	360	420	480	540
2	120	240	360	480	600	720	840	960	1080
3	180	360	540	720	900	1080	1260	1440	1620
MONTHS	\$1000	\$2000	\$3000	\$4000	\$5000	\$6000	\$7000	\$8000	\$9000
1	5	10	15	20	25	30	35	40	45
2	10	20	30	40	50	60	70	80	90
3	15	30	45	60	75	90	105	120	135
DAYS	\$1000	\$2000	\$3000	\$4000	\$5000	\$6000	\$7000	\$8000	\$9000
1	.167	.333	.50	.667	.833	1.00	1.167	1.333	1.50
2	.333	.667	1.00	1.333	1.667	2.00	2.333	2.667	3.00
3	.500	1.000	1.50	2.000	2.500	3.00	3.500	4.000	4.50
4	.667	1.333	2.00	2.667	3.333	4.00	4.667	5.333	6.00
5	.833	1.667	2.50	3.333	4.167	5.00	5.833	6.667	7.50
6	1.000	2.000	3.00	4.000	5.000	6.00	7.000	8.000	9.00

NOTE. To find the interest on \$6350, add the interest on \$6000, on \$300 ( $\frac{1}{10}$  of \$3000), and on \$50 ( $\frac{1}{10}$  of \$5000).

## TABLE OF TIME BETWEEN DATES

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Jan.	365	31	59	90	120	151	181	212	243	273	304	334
Feb.	334	365	28	59	89	120	150	181	212	242	273	303
Mar.	306	337	365	31	61	92	122	153	184	214	245	275
Apr.	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	333	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
Aug.	153	184	212	243	273	304	334	365	31	61	92	122
Sept.	122	153	181	212	242	273	303	334	365	30	61	91
Oct.	92	123	151	182	212	243	273	304	335	365	31	61
Nov.	61	92	120	151	181	212	242	273	304	334	365	30
Dec.	31	62	90	121	151	182	212	243	274	304	335	365

The number of days from any day of one month to the same day of another month is found by starting at the name of the first (in the left-hand column) and following across to the column headed with the name of the second. (Should Feb. 29th of a leap year intervene between dates, add 1 day.) Suppose it is required to find the number of days from June 5 to Nov. 10. From the table we find that it is 153 days from June 5 to Nov. 5; adding 5 days, we find the required time to be 158 days.

# SQUARES AND SQUARE ROOTS OF NUMBERS

NUMBER	SQUARE	SQUARE ROOT	NUMBER	SQUARE	SQUARE ROOT
1	1	1	51	2601	7.141
2	4	1.414	52	2704	7.211
3	9	1.732	53	2809	7.280
4	16	2	54	2916	7.348
5	25	2.236	55	3025	7.416
6	36	2.449	56	3136	7.483
7	49	2.646	57	3249	7.550
8	64	2.828	58	3364	7.616
9	81	3	59	3481	7.681
10	100	3.162	60	3600	7.746
11	121	3.317	61	3721	7.810
12	144	3.464	62	3844	7.874
13	169	3.606	63	3969	7.937
14	196	3.742	64	4096	8
15	225	3.873	65	4225	8.062
16	256	4	66	4356	8.124
17	289	4.123	67	4489	8.185
18	324	4.243	68	4624	8.246
19	361	4.359	69	4761	8.307
20	400	4.472	70	4900	8.367
21	441	4.583	71	5041	8.426
22	484	4.690	72	5184	8.485
23	529	4.796	73	5329	8.544
24	576	4.899	74	5476	8.602
25	625	5	75	5625	8.660
26	676	5.099	76	5776	8.718
27	729	5.196	77	5929	8.775
28	784	5.291	78	6084	8.832
29	841	5.385	79	6241	8.888
30	900	5.477	80	6400	8.944
31	961	5.568	81	6561	9
32	1024	5.657	82	6724	9.055
33	1089	5.745	83	6889	9.110
34	1156	5.831	84	7056	9.165
35	1225	5.916	85	7225	9.220
36	1296	6	86	7396	9.274
37	1369	6.083	87	7569	9.327
38	1444	6.164	88	7744	9.381
39	1521	6.245	89	7921	9.434
40	1600	6.325	90	8100	9.487
41	1681	6.403	91	8281	9.539
42	1764	6.481	92	8464	9.592
43	1849	6.557	93	8649	9.644
44	1936	6.633	94	8836	9.695
45	2025	6.708	95	9025	9.747
46	2116	6.782	96	9216	9.798
47	2209	6.856	97	9409	9.849
48	2304	6.928	98	9604	9.899
49	2401	7	99	9801	9.950
50	2500	7.071	100	10000	10

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# ANSWERS TO

## HAMILTON'S ESSENTIALS OF ARITHMETIC

### HIGHER GRADES

**Page 10.** — 2. 4868. 3. 4283. 4. 5275. 5. 5765. 6. 5736.  
 7. \$4036.10. 8. \$4558.62. 9. \$4752.19. 10. \$4631.39. 11. \$3946.34.  
 12. 3,165,444. 13. 20,781.38. 14. 1432.6082. 15. 1432.7396.

**Page 11.** — 16. 9046. 17. 17,927. 18. 5677. 19. \$261.37.  
 20. \$550.29. 21. \$374.40. 22. 218,539. 23. 377,065. 24. 714,408.  
 25. 460,878. 26. 371,786. 27. 366,759. 28. 11,187. 29. 22,464.  
 30. 27,132. 31. \$378.16. 32. \$658.53. 33. \$236.90. 34. 459,409.  
 35. 103,606. 36. 278,102. 37. 3,278,193. 38. 3,599,897. 39. 717,721.  
 40. 8.057. 41. 3.0865. 42. 8.9435. 43. 88.945. 44. 4.3633.  
 45. .0401. 46. 3275.86. 47. 14.6813. 48. 85.7844. 49. 21,798.77.  
 50. 54.4044. 51. 94.4972.

**Page 13.** — 15. 48,683. 16. 53,742. 17. 84,108. 18. 3,290,427.  
 19. \$5,070,000. 20. \$43,978.50. 21. \$43,256.40. 22. \$.09.  
 23. \$.30. 24. \$2.88. 25. \$2.95. 26. \$.15. 27. \$2094.75.  
 28. \$1193.25. 29. 1.5288. 30. 1.8144. 31. 2.375. 32. .029187.  
 33. 12.9795. 34. .5304. 35. 2.14326. 36. 1.2564. 37. 6.336.  
 38. 2.334. 39. .002478. 40. .014944. 41. .018202. 42. .000008.  
 43. 3515.5. 44. 3145. 45. 1858.995. 46. 980.875. 47. .000282.  
 48. .29939. 49. 223.479. 50. 20.1978. 51. 26.274. 52. 478.575.  
 53. 17.876. 54. 5.6515. 55. 40.6912. 56. 4.28945. 57. .04968.  
 58. .00352. 59. .31527. 60. .4725. 61. .03009. 62. 3.97494.  
 63. 151.1016. 64. .016779. 65. .3597. 66. .355272. 67. 4.524.  
 68. 2.5875. 69. 2.871. 70. 105.975. 71. 16.1579. 72. 202.6125.  
 73. 1663.9875. 74. 904.86515. 75. 20.965925. 76. 71.5707. 77. 85.8695.

**Page 14.** — 11. 4615. 12. 5712. 13. 6309. 14. 1362. 15. \$72.16.  
 16. \$10.15. 17. \$140.771. 18. \$175.972.

**Page 15.** — 19. 20. 20. 200. 21. 20,000. 22. 3000. 23. .03.  
 24. 3000. 25. 200. 26. 20. 27. 2000. 28. 800. 29. 800. 30. 80,000.  
 31. 5000. 32. 50. 33. 500. 34. 500. 35. 5000. 36. 50. 37. 2.  
 38. 20. 39. 2. 40. 2000. 41. 800. 42. .8. 43. 800. 44. 80.  
 45. 3. 46. .056. 47. 75. 48. 17. 49. .9. 50. 35. 51. 7. 52. 28.  
 53. 74. 54. 111. 55. 103. 56. 12.5. 57. 27. 58. 90. 59. 52.  
 60. .4571. 61. 982. 62. 64.2. 63. 17.5. 64. 111.1. 65. 175.  
 66. 123. 67. 1420. 68. 120. 69. 65.2. 70. 376. 71. 12.6. 72. .0154.  
 73. 1243. 74. 1112. 75. 615. 76. 36.5. 77. 1420. 78. 262.6.  
 79. 50.5. 80. 189.6. 81. 935. 82. 1006. 83. 115. 84. 707.  
 85. 1685. 86. 1.009. 87. 824. 88. 5050. 89. 1.25. 90. 8256.7.  
 91. 10.2. 92. .0575. 93. 1115. 94. 989.1. 95. 150.1. 96. 15.55.

**Page 16.** — 6. 18. 7. 12. 8. 40. 9. 24. 10. 36. 11. 6. 12. 42.  
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 22.  $\frac{1}{11}$ . 23.  $\frac{1}{9}$ . 24.  $\frac{1}{7}$ . 25.  $\frac{1}{15}$ . 26.  $\frac{1}{4}$ . 27.  $\frac{1}{4}$ . 28.  $\frac{1}{17}$ . 29.  $\frac{1}{8}$ .  
 30.  $\frac{1}{11}$ . 31.  $\frac{1}{4}$ . 32.  $\frac{1}{10}$ . 33.  $\frac{1}{4}$ . 34.  $\frac{1}{4}$ . 35.  $\frac{1}{8}$ . 36.  $\frac{1}{6}$ . 37.  $\frac{1}{11}$ .  
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 63.  $\frac{1}{10}$ . 64.  $\frac{1}{10}$ . 65.  $\frac{1}{10}$ . 66.  $\frac{1}{10}$ .

Page 19.—3.  $\frac{1}{11}$ . 4.  $\frac{1}{11}$ . 5.  $\frac{1}{15}$ . 6.  $\frac{1}{4}$ . 7.  $\frac{1}{4}$ . 8.  $\frac{1}{11}$ . 9.  $\frac{1}{11}$ .  
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 71.  $\frac{1}{11}$ . 72.  $\frac{1}{11}$ . 73.  $\frac{1}{11}$ . 74.  $\frac{1}{11}$ .

Page 20.—6. 21. 7. 22. 8. 88. 9. 22. 10. 95. 11.  $\frac{1}{10}$ .

Page 21.—12.  $\frac{1}{11}$ . 13.  $\frac{1}{15}$ . 14.  $\frac{1}{15}$ . 15.  $\frac{1}{15}$ . 16.  $\frac{1}{11}$ . 17.  $\frac{1}{10}$ .  
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 25.  $\frac{1}{10}$ . 26. 44. 27.  $\frac{1}{11}$ . 28. 470. 29. 72. 30. 44. 31. 344.  
 32. 530. 33. 5136. 34. 10. 35. 6. 36. 1. 37. 2. 38. 1.  
 39. 9. 40. 20,743. 41. 80,726. 42. 24,970. 43. 19,929.  
 44. 33,823.

Page 22.—7. 6. 8. 12. 9.  $\frac{1}{10}$ . 10.  $\frac{1}{10}$ . 11. 60. 12. 24.  
 13.  $\frac{1}{10}$ . 14.  $\frac{1}{11}$ . 15.  $\frac{1}{11}$ . 16.  $\frac{1}{11}$ . 17.  $\frac{1}{11}$ . 18.  $\frac{1}{11}$ . 19.  $\frac{1}{11}$ .  
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 34. 8. 35. 4. 36. 5. 37. 12. 38.  $\frac{1}{11}$ . 39. 2. 40. 3.  
 41.  $\frac{1}{11}$ . 42.  $\frac{1}{11}$ . 43. 3210. 44. 1643. 45. 816. 46. 1375.  
 47. 3306. 48. 500. 49. 369. 50. 273. 51. 883.  
 52. 787. 53.  $\frac{1}{11}$ . 54.  $\frac{1}{10}$ . 55. 10. 56. 2.

Page 23.—3.  $\frac{1}{11}$ . 4.  $\frac{1}{17}$ . 5.  $\frac{1}{4}$ . 6.  $\frac{1}{4}$ . 7.  $\frac{1}{11}$ . 8.  $\frac{1}{11}$ . 9.  $\frac{1}{11}$ .  
 10.  $\frac{1}{11}$ . 12. 8000. 13.  $\frac{1}{11}$ . 14. 60. 15. 120. 16. 3. 17. 4.  
 18.  $\frac{1}{11}$ . 19. 3. 20. 36. 21. 4.

Page 24.—1. \$3. 2. \$9. 3. \$20. 4. \$3. 5. \$5. 6. \$60.  
 7. \$4. 8. \$15. 9. \$49. 10. 16 yd. 11. 36 yd. 12. 16 yd.  
 13. 120 yd. 14. 432 yd. 15. 84 yd. 16. 512 yd. 17. 80 yd.  
 18. 90 yd.

3.  $\frac{1}{11}$ . 4.  $\frac{1}{11}$ . 5.  $\frac{1}{11}$ . 6.  $\frac{1}{11}$ . 7.  $\frac{1}{10}$ . 8.  $\frac{1}{11}$ . 9.  $\frac{1}{11}$ .  
 10.  $\frac{1}{10}$ . 11.  $\frac{1}{10}$ . 12.  $\frac{1}{11}$ . 13.  $\frac{1}{11}$ . 14.  $\frac{1}{11}$ . 15.  $\frac{1}{11}$ . 16.  $\frac{1}{11}$ .  
 17.  $\frac{1}{11}$ . 18.  $\frac{1}{11}$ . 19.  $\frac{1}{11}$ . 20.  $\frac{1}{11}$ . 21.  $\frac{1}{11}$ . 22.  $\frac{1}{11}$ . 23.  $\frac{1}{11}$ .  
 24. 375. 25. 625. 26. 875. 27. 666. 28. 833. 29. 416. 30. 3125. 31. 35.  
 32. 777. 33. 857. 34. 3636. 35. 2142. 36. 0266.

37. .1388. 38. .0347. 39. .4375. 40. .2187. 41. .075.  
42. .055. 43. .045. 44. .035. 45. .85. 46. .76. 47. .2333.  
48. .84.

Page 25.—3. 15¢. 4. 2¢.

Page 26.—5. \$1.50 an hour. 6. \$120. 7. 24 weeks 8. 13¢.  
9. 20 lemons. 10. 60¢. 11. \$23.75. 12. \$.21. 13. \$.94.  
14. \$.86. 15. Food, \$1485; rent, \$1080; clothing, \$585;  $\frac{7}{10}$ .  
16. Food,  $\frac{7}{10}$ ; clothing,  $\frac{1}{5}$ ; rent,  $\frac{1}{5}$ .

Page 27.—17. (a) 1981 ships; (b) 5,753,490 T.; (c) England, 3441.54 T.;  
United States, 3818.86 T.; Japan, 4410.30 T.; France, 2429.57 T.;  
Germany, 2035.03 T.; Russia, 2413.60 T.; Italy, 1250.05 T.; (d) 1,484,159 T.;  
(e) 332,002 T.; (f) 19,133 T.; (g) 18,999 T.; (h) 185,147 T.; (i) 89,457 T.  
18.  $\frac{7}{10}$ . 19. 20.549 pounds sterling; 24.067 pounds sterling. 20. \$.112;  
\$.081. 21. .16.

Page 32.—3. 59.04. 4. \$23.94. 5. 55.23. 6. \$29.45.  
7. 236.16. 8. 5.4. 9. 15. 10. 300. 11. 147.

Page 33.—12. \$32. 13. 3 $\frac{3}{4}$  mo. 14. 18 da. 15. 18 A. 16. 90  
T. 17. \$72. 18. \$135. 19. \$3 $\frac{3}{10}$ . 20. 27 lb. 21. \$1.125.  
23. 4 words. 24. \$6.20. 25. \$1650. 28. 8.55 T. 29. \$525.  
30. \$40.60.

Page 34.—31. 53¢. 32. \$20. 33. \$3.60. 34. \$3.96; \$4.07;  
\$4.18; \$4.29; \$4.40; \$4.84. 35. The same. 36. \$1400.  
37. \$292,702.50. 38. \$4.80; \$8.20. 39. John, \$380; James, \$332.50;  
Henry, \$237.50. 40. 340,600,000 bu..

Page 35.—41. \$1; \$9; \$10; \$15; \$15. 42. 12,000,000 families.  
43. 276 bu. 44. 4875 tractors. 45. \$375.75. 46. \$423.465. 47. 180  
girls; 220 boys. 48. \$12. 49. 25.2 T. 50. \$15,906,000,000.  
51. \$196.

Page 36.—52. \$30. 53. \$150. 54. \$152.88. 55. \$2640.  
56. \$15; \$90. 57. \$32; \$128. 58. \$17.25; \$97.75. 59. \$43.13;  
\$183.87. 60. \$74.76; \$430.76. 61. \$37.10; \$169.60. 62. \$24.28;  
\$461.32. 63. \$110.10; \$990.90. 65. \$1750. 66. \$1120.  
67. \$8145.

Page 37.—2. 40%. 3. 37 $\frac{1}{2}$ %. 4. 66 $\frac{2}{3}$ %. 5. 60%. 6. 30%.  
7. 75%. 8. 25%. 9. 33 $\frac{1}{3}$ %. 10. 55 $\frac{1}{3}$ %. 11. 37 $\frac{1}{2}$ %. 12. 20%.  
13. 33 $\frac{1}{3}$ %. 14. 30%. 15. 333 $\frac{1}{3}$ %. 16. 400%.

Page 38.—18. 60%. 19. 33 $\frac{1}{3}$ %. 20. 50%. 21. 33 $\frac{1}{3}$ %.  
22. 25%; 12 $\frac{1}{2}$ %. 23. 6 $\frac{1}{4}$ %. 24. 8 $\frac{1}{4}$ %. 25. 4%. 26. 43.2%.  
27. 28.4%. 28. 17.1%. 29. 28.6%. 30. 18 $\frac{1}{4}$ %. 31. 24%.  
32. 28.6%. 33. 25%.

Page 39.—34. 200%. 35. 127.6%. 36. 171.4%. 37. 362.5%.  
38. 320%. 39. 185.7%. 40. 90%. 41. 8.4%. 42. 37 $\frac{1}{2}$ %.  
43. 83.7%. 44. 20%. 45. 5%. 46. 51.8%.

Page 40.—48. 25 %. 49. 20 %. 50.  $33\frac{1}{3}\%$  gain. 51.  $14\frac{1}{2}\%$  loss. 52. 50 % gain. 53. 42.9 % gain. 54. 25 % gain. 55. 20 % loss. 56. 20 % gain. 57.  $14\frac{1}{2}\%$  loss. 58. 20 % loss. 59.  $33\frac{1}{3}\%$  loss. 60. 25 %;  $16\frac{1}{2}\%$ . 61. 20 %; 25 %.

Page 42.—3. \$140. 4. \$12,500,000. 5. \$30. 6. \$30. 7. \$728. 8. \$72. 9. \$127.50. 10. \$1200. 11. \$12. 12. \$8. 13. \$58. 14. \$32.32. 15. 20 examples. 16. \$3.20. 17. \$50. 18. 920 men. 21. 10 sq. mi.

Page 43.—1. 90 %. 2. 80 %. 3. 63.6 %. 4.  $83\frac{1}{3}\%$ . 5. 25 %. 6.  $16\frac{1}{2}\%$ . 7. 72.7 %. 8. 75 %. 9. 64.9 %. 10. 59.2 %. 11. 57.1 %. 12. 51 %. 13. 48.4 %. 14. 46.4 %. 15. 37 %. 16. 35.9 %. 18. 34.1 %. 19. 31.2 %. 20. 30.2 %. 21. 29.7 %. 22. 29.4 %. 23. 28.6 %. 24. 27.9 %. 25. 27.8 %.

Page 44.—1. 835.5 %; \$.68. 2. 572.6 %; \$.51. 3. 221.1 %; \$.59. 4. 1627.9 %; \$1.42. 5. 740.4 %; \$.02. 6. 411.7 %; \$.02. 7. 637.6 %; \$.02. 8. 263.6 %; \$.01. 9. 166.4 %; \$.31. 10. 96.8 %; \$.11. 11. 181.8 %; \$.46. 12. 157.5 %; \$.23. 13. 251.9 %; \$.358. 14. 120.5 %; \$.273. 15. 390.8 %; \$.02. 16. 167.9 %; \$.01. 17. 83.3 %; \$.03. 18. 393.2 %; \$.02. 19. 725.6 %; \$.08. 20. 372.5 %; \$.03. 21. 295.9 %; \$.01. 22. 400 %; \$1.02. 23. 386.5 %; \$1.02. 24. 515.4 %; \$.56.

Page 45.—1. 168 lb. 2. 23.4 lb. 3. 18.36 lb. 4. 26.8 lb. 5. 23.65 lb. 6. 28.7 lb. 7. 23.4 lb. 8. 4.7 %. 9. 5.5 %. 10. 4.6 %. 11. 3.1 %. 12. 30 bu. 13.  $37\frac{1}{2}\%$ .

Page 47.—1. \$126.57. 2. \$1145. 3. \$1248. 4. \$174. 5. \$1818. 6. \$180.52. 7. \$250.20. 8. \$328.24. 9. \$110.10. 10. \$560.40. 11. \$612.85. 12. \$251.01. 13. \$2283.36. 14. \$6436.44. 15. \$7777.77. 16. \$2553.45. 17. \$935. 18. \$1890. 19. \$7820. 20. \$11,000. 21. 20 %. 22. 20 %. 23. 25 %. 24.  $33\frac{1}{3}\%$ . 25. 25 %. 26. 25 %. 27. 50 %. 28. 25 %. 29. 25 %. 30.  $33\frac{1}{3}\%$ . 31. 25 %. 32. 20 %.

Page 48.—1. \$.50. 2. \$.50. 3. \$.60. 4. \$.15. 5. \$.3. 6. \$.20. 7. \$.5. 8. \$.20. 9. \$.10. 10. 60 %. 11. 25 %. 12. 25 %. 13. 20 %. 14. 40 %. 15. 23.4 %. 16. 36 %. 17. 17.9 %.

Page 49.—1. \$125. 2. \$3.75. 3. \$15. 4. \$30. 5. \$10. 6. \$1350. 7. \$20; \$10; \$4.

Page 50.—2. \$48.87. 3. \$288. 4. \$267.55. 5. \$157.04. 6. \$6.13. 7. \$4.59. 8. \$7.65. 9. \$238.04. 10. \$83.79. 11. \$129.60. 12. \$4080. 13. \$1890. 14. \$291.60; \$21.60 more than 50 % discount.

Page 51.—15. \$31.92. 16. \$231.60. 17. 24.7 %. 18. \$38.48. 19. 10 % discount, \$2.50 better. 20. None. 21. (3) is best; \$208 better than (1), \$135 better than (2). 22. \$70.13. 23. \$1525.95. 24. 56.8 %.

Page 52.—2. \$547.20.

Page 53.—3. \$564.48. 4. \$39.34. 5. \$407.80. 6. \$1289.25. 7. \$3182.50. 8. \$1392.

Page 55.—1. \$159.88. 2. \$185.66. 3. \$17.57.



# ANSWERS

V

Page 57.—1. \$7.87. 2. \$97.78.

Page 58.—1. \$21. 2. \$68.75.

Page 59.—3. \$78.18. 4. \$365.75. 5. \$4037.50. 6. \$18.  
7. \$378.50. 8. \$192. 9. \$126. 10. \$83.88. 11. \$171.88.  
12. \$150.22. 13. \$22.75. 15. \$24,375.

Page 60.—16. 2%. 17. \$1851.35. 18. \$2120 loss. 19. \$75.90.  
20. \$17,512.50. 21. \$13,650.88. 22. \$306. 23. \$1595.80; \$3940.

Page 63.—2. \$15. 3. \$98. 4. \$22. 5. \$18. 6. \$6.40.  
7. \$9.36. 8. \$171. 9. \$19. 10. \$128.27. 11. \$9. 12. \$19.20.  
13. \$19.25. 14. \$43.20. 15. \$173.25. 16. \$29.43. 17. \$15.40.  
18. \$33.75. 19. \$28.50. 20. \$56. 21. \$36. 22. \$180.95.  
23. \$29.25. 24. \$15.75. 25. \$700.

Page 64.—27. \$46.20; \$706.20. 28. \$73.24; \$530.99. 29. \$54;  
\$729. 30. \$192; \$1392. 31. \$16.48; \$100.98. 32. \$13.61; \$104.36.  
33. \$92.75; \$622.75. 34. \$24.50; \$174.50. 35. \$30.25; \$305.25.  
36. \$16; \$136. 37. \$16.67; \$641.67. 38. \$86; \$486. 39. \$40.10;  
\$315.10. 40. \$1.06; \$51.06. 41. \$10; \$510. 42. \$13; \$163.  
43. \$6.24; \$630.24. 44. \$267.50. 45. \$33.75. 46. \$302.50.

Page 65.—2. \$16.25, \$516.25; \$10.83, \$510.83; \$12.19, \$512.19;  
\$14.90, \$514.90. 3. \$10.83, \$260.83; \$7.22, \$257.22; \$8.13, \$258.13;  
\$9.93, \$259.93. 4. \$9.60, \$369.60; \$6.40, \$366.40; \$7.20, \$367.20;  
\$8.80, \$368.80. 5. \$7.13, \$482.13; \$4.75, \$479.75; \$5.34, \$480.34;  
\$6.53, \$481.53. 6. \$30.75, \$930.75; \$20.50, \$920.50; \$23.06, \$923.06;  
\$28.19, \$928.19. 7. \$2.90, \$127.90; \$1.93, \$126.93; \$2.17, \$127.17;  
\$2.65, \$127.65. 8. \$11, \$336; \$7.33, \$332.33; \$8.25, \$333.25; \$10.08,  
\$335.08. 9. \$51, \$26.01; \$34, \$25.84; \$38, \$25.88; \$46, \$25.96.  
10. \$3.07, \$178.57; \$2.05, \$177.55; \$2.30, \$177.80; \$2.82, \$178.32.  
11. \$7.05, \$167.05; \$4.70, \$154.70; \$5.29, \$155.29; \$6.46, \$156.46.  
12. \$13.24, \$400.74; \$8.83, \$396.33; \$9.93, \$397.43; \$12.14, \$399.64.  
13. \$6.71, \$132.21; \$4.48, \$129.98; \$5.04, \$130.54; \$6.15, \$131.65.  
14. \$11.23, \$356.73; \$7.49, \$352.99; \$8.42, \$353.92; \$10.29, \$355.79.  
15. \$80.03, \$835.03; \$53.35, \$808.35; \$60.02, \$815.02; \$73.36, \$828.36.

Page 66.—2. \$115.48; \$76.98; \$96.23. 3. \$91; \$60.67; \$75.83.  
4. \$65.33; \$43.56; \$54.44. 5. \$101.28; \$67.52; \$84.40. 6. \$4.58;  
\$3.06; \$3.82. 7. \$9; \$6; \$7.50. 8. \$19.85; \$13.24; \$16.55.  
9. \$114.49; \$76.33; \$95.41. 10. \$73.02; \$48.68; \$60.85. 11. \$77.25;  
\$51.50; \$64.38. 12. \$169.30; \$112.87; \$141.08. 13. \$219.75;  
\$146.50; \$183.13. 14. \$247.50; \$165; \$206.25. 15. \$2.40; \$1.60;  
\$2. 16. \$4.77; \$3.18; \$3.98. 17. \$6.18; \$4.12; \$5.15. 18. \$10.50;  
\$7; \$8.75. 19. \$47.60; \$31.73; \$39.67. 20. \$60.50; \$40.33;  
\$50.42. 21. \$38.25; \$25.50; \$31.88. 22. \$145.13; \$96.75; \$120.94.  
23. \$10.66; \$7.11; \$8.88.

Page 67.—2. \$2; \$1.33; \$1.67. 3. \$.95; \$.63; \$.79. 4. \$4.80;  
\$3.20; \$4. 5. \$5; \$3.33; \$4.17. 6. \$10.50; \$7; \$8.75. 7. \$2;  
\$1.33; \$1.67. 8. \$1.50; \$1; \$1.25. 9. \$7; \$4.67; \$5.83. 10. \$2;  
\$1.33; \$1.67. 11. \$44.96; \$29.97; \$37.47. 12. \$13.40; \$8.93; \$11.17.  
13. \$9.99; \$6.66; \$8.33. 14. \$30; \$20; \$25. 15. \$34.83; \$23.22;  
\$29.03. 16. \$16.25; \$10.83; \$13.54. 17. \$10.83; \$7.22; \$9.03.

18. \$9.60; \$6.40; \$8. 19. \$7.13; \$4.75; \$5.94. 20. \$30; \$20; \$25.  
 21. \$3.15; \$2.10; \$2.63. 22. \$3.25; \$2.17; \$2.71. 23. \$10.06;  
 \$6.71; \$8.39. 24. \$5.31; \$3.54; \$4.43. 25. \$2.50; \$1.67; \$2.08.  
 26. \$2.10; \$1.40; \$1.75. 27. \$31.05; \$20.70; \$25.88. 28. \$59.50;  
 \$39.67; \$49.58. 29. \$31.36; \$20.91; \$26.13. 30. \$25.34; \$16.89;  
 \$21.12. 31. \$5.63; \$3.75; \$4.69. 32. \$.74; \$.49; \$.61. 33. \$2.25;  
 \$1.50; \$1.88. 34. \$13; \$8.67; \$10.83. 35. \$2.67; \$1.78; \$2.22.

Page 68. — 36. \$4.08. 37. \$10.28. 38. \$12.33. 39. \$12.36.  
 40. \$40.63. 41. \$4.64. 42. \$31.93. 43. \$31.34. 44. \$571.77.  
 45. \$151.59. 46. \$559.46. 47. \$415.28. 48. \$680. 50. \$144.71.  
 51. \$3697.15. 52. \$97.64.

Page 69. — 2. \$1000. 3. \$2000. 4. \$1000.

Page 70. — 2. 6%. 3. 5%. 4. 4%. 5. 4%. 6. 5%.  
 7. 5%. 8. 8%.  
 2. 2 yr. 3. 3 yr. 4. 4 yr. 5. 3 yr. 4 mo. 6. 20 yr.; 16 yr.  
 8 mo.; 12 yr. 6 mo. 7. 40 yr.; 33 yr. 4 mo.; 37 yr. 6 mo.; 30 yr.  
 8. 2 yr. 6 mo. 18 da. 9. 1 yr.

Page 71. — 1. 10 c. 2.  $1\frac{1}{2}$  c. 3. 64 tbsp. 4.  $\frac{3}{4}$  lb. 5.  $\frac{1}{2}$  lb.  
 6.  $\frac{1}{2}$  lb. 7. 60 tsp.;  $6\frac{1}{2}$   $\phi$ . 8. 80 tbsp.; \$1.50. 9. 40  $\phi$ . 10. 60  $\phi$ .

Page 72. — 11.  $6\frac{3}{4}$   $\phi$ . 12. 90  $\phi$ . 13. 40 tbsp.;  $6\frac{1}{2}$   $\phi$ . 14. \$4.45 $\frac{1}{2}$ ;  
 22 $\frac{1}{10}$   $\phi$ . 15. 16 ears. 16.  $1\frac{1}{2}$  c. 17.  $\frac{1}{2}$  c. 18. 200%; 600%; 300%.  
 19. \$60. 20.  $1\frac{1}{2}$  qt. onions; 3 peppers;  $\frac{1}{2}$  c. salt;  $\frac{1}{2}$  c. sugar;  $\frac{1}{2}$  c. cinna-  
 mon;  $\frac{3}{4}$  qt. vinegar. 21. 5 c. flour; 10 tbsp. baking powder;  $2\frac{1}{2}$  tsp. salt;  
 $2\frac{1}{2}$  tbsp. lard;  $1\frac{1}{2}$  c. milk;  $2\frac{1}{2}$  tbsp. butter.

Page 73. — 22.  $\frac{4}{10}$  of a bag. 23. 43 $\frac{1}{2}$   $\phi$ . 24.  $3\frac{1}{2}$  qt. milk;  $3\frac{1}{2}$  c.  
 sugar;  $3\frac{1}{2}$  c. cream. 25.  $\frac{3}{10}$  lb. wheat flour;  $\frac{3}{8}$  lb. rye flour. 26. \$30;  
 \$20. 27.  $\frac{1}{2}$  c. 28. \$302.40.

Page 74. — 29.  $\frac{3}{4}$  c. barley flour;  $\frac{3}{8}$  tsp. salt;  $\frac{3}{8}$  c. corn flour;  $\frac{3}{4}$  tbsp.  
 sugar;  $1\frac{1}{2}$  tbsp. fat; 3 tsp. baking powder;  $\frac{3}{4}$  c. milk;  $\frac{1}{2}$  egg.  $1\frac{1}{2}$  c. barley  
 flour;  $1\frac{1}{2}$  c. corn flour;  $\frac{3}{4}$  tsp. salt;  $1\frac{1}{2}$  tbsp. sugar; 3 tbsp. fat; 6 tsp.  
 baking powder;  $1\frac{1}{2}$  c. milk;  $1\frac{1}{2}$  eggs. 30. \$.68. 31.  $2\frac{1}{2}$  c. mashed  
 potatoes;  $2\frac{1}{2}$  c. cornmeal;  $1\frac{1}{2}$  c. barley flour; 10 tsp. baking powder; 5  
 tbsp. milk; 5 tbsp. fat;  $2\frac{1}{2}$  eggs;  $2\frac{1}{2}$  tsp. salt. 32.  $\frac{3}{4}$  c. fresh corn;  $\frac{3}{4}$  tsp.  
 lemon juice;  $\frac{3}{4}$  tbsp. butter;  $\frac{1}{2}$  egg;  $\frac{1}{2}$  c. bread crumbs;  $1\frac{1}{2}$  tbsp. cheese.  
 33.  $3\frac{1}{2}$  c. mashed potatoes;  $3\frac{1}{2}$  c. flaked fish; 2 c. canned tomatoes;  $1\frac{1}{2}$  tbsp.  
 fat;  $3\frac{1}{2}$  tbsp. onion;  $\frac{3}{4}$  green pepper;  $\frac{3}{4}$  tsp. salt;  $\frac{3}{4}$  tsp. paprika;  $1\frac{1}{2}$  tbsp.  
 barley flour.

Page 75. — 34.  $1\frac{1}{2}$  c. mashed potatoes;  $1\frac{1}{2}$  c. corn meal;  $2\frac{1}{2}$  c. water;  
 $1\frac{1}{2}$  tbsp. fat; 3 eggs;  $1\frac{1}{2}$  c. milk; 3 tsp. salt. 35.  $7\frac{1}{2}$  small potatoes;  $1\frac{1}{2}$   
 egg yolks;  $2\frac{1}{2}$  tbsp. fat;  $4\frac{1}{2}$  tsp. parsley;  $\frac{3}{4}$  tsp. salt;  $\frac{3}{8}$  tsp. pepper;  $\frac{3}{4}$  c.  
 cheese;  $\frac{3}{4}$  egg;  $\frac{3}{4}$  c. corn meal. 36. 2 lb.; 1 lb.; .95 lb. 37. 1.719 lb.;  
 .8235 lb.; .855 lb. 38. 1.092 lb.; .648 lb.; .402 lb. 39. 1.06425 lb.;  
 .703875 lb.; .307875 lb. 40. 1.4 lb.; .7 lb.; .665 lb. 41. 1.2771 lb.;  
 .84465 lb.; .36945 lb. 42. 27.3% inc. 43. 26.9% inc. 44. 20.9% inc.  
 45. 22.5% inc. 46. 23.3% inc. 47. 22.2% inc. 48. 6.9% dec.  
 49. 19.6% inc. 50. 18.2% inc. 51. 9.3% dec. 52. 13.3% inc.  
 53. 8.3% inc. 54. 16.7% inc. 55. 27.3% inc.

# ANSWERS

vii

Page 76. — 1.  $8\frac{1}{2}$  in. 2. 7 waists; 38¢. 3. \$1.37. 4. 8 yd. 31 in.  
5.  $2\frac{1}{2}$  in. 6.  $8\frac{1}{2}$  in. 7. 48 tucks. 8. 8 dresses; 18¢. 9.  $11\frac{1}{4}$  hr.

Page 77. — 10. 8 towels. 11.  $17\frac{1}{2}$  yd. 12. 4 yd.  
1. \$1.88. 2. \$4.80. 3. \$78. 4. \$.66 $\frac{1}{2}$ . 5. \$.41 $\frac{1}{2}$ .

Page 78. — 6. 28 $\frac{1}{2}$ %. 7. \$.25. 8. 33 $\frac{1}{2}$ %; 16 $\frac{1}{2}$ %; 23.6%.  
9. \$29.40. 10. \$110.12. 11. \$81.75. 12. \$3.22.

Page 79. — 13. \$26.69. 14. \$3.94. 15. \$103.86. 16. \$121.90.  
17. \$75; \$37.50. 18. \$120. 19. 6%.

Page 81. — 1. 2,679,183. 2. 3,226,844. 3. \$36,759.04. 4.  $72\frac{1}{8}$ .  
5. 476 $\frac{1}{8}$ . 6. 848 $\frac{1}{2}$ . 7. 604 $\frac{1}{2}$ . 8. 79 $\frac{1}{2}$ . 9. 1280 $\frac{1}{8}$ . 10. 114.465.  
11. 1294.328. 12. 2023.5535. 13. 179.2381. 14. 5158.9123.  
15. 14,071.7124. 16.  $10\frac{1}{2}$  yd. 17.  $9\frac{1}{2}$  ft. 18. 25 $\frac{1}{2}$  min. 19. 16 $\frac{1}{2}$  pk.  
20. 12 yd. 21. 12 $\frac{1}{2}$  lb. 22.  $10\frac{2}{3}$  mi. 23. 10 $\frac{1}{2}$  doz. 24. 6 yr.

Page 82. — 25. 578,803. 26. 58,906. 27. 324,440. 28. 308,643.  
29. \$1353.43. 30. \$1556.02. 31. 608,8455. 32. 475.3194. 33. 373.0523.  
34. 18.5474. 35. 724.9762. 36. 1715.9211. 37. 247 $\frac{1}{2}$ . 38. 385 $\frac{1}{2}$ .  
39. 124 $\frac{3}{4}$ . 40. 3517 rd. or 10 mi. 317 rd. 41. 7 $\frac{1}{2}$  wk. or 7 wk. 6 da.  
42. 2 $\frac{1}{2}$  doz. 43. 4 $\frac{1}{2}$  yd. or 4 yd. 27 in. 44. 1 $\frac{1}{2}$  lb. or 1 lb. 6 oz.  
45. 1 $\frac{1}{2}$  gal. or 1 gal. 3 qt. 46. 4,764,564. 47. 3,129,505. 48. \$5135.52.  
49.  $\frac{1}{16}$ . 50.  $\frac{1}{4}$ . 51. 884 $\frac{1}{2}$ . 52. 30.91284. 53. .058128. 54. .005748.  
55. \$26,519.85. 56. 1091 $\frac{1}{2}$ . 57. 242.40172. 58. 15.888. 59. 18.894.  
60. .020. 61. 1 $\frac{1}{2}$ . 62. 1 $\frac{1}{2}$ . 63. 8 $\frac{1}{2}$ . 64. 75. 65. 1.726. 66. 246.827.  
67. 1 $\frac{1}{2}$  gal. 68. 1 $\frac{3}{4}$  ft. 69. 6.395.

Page 83. — 70.  $\frac{1}{2}$ . 71.  $4\frac{1}{2}$ . 72.  $\frac{2}{3}$ . 73.  $2\frac{1}{2}$ . 74.  $\frac{1}{4}$ . 75.  $3\frac{1}{2}$ .  
76.  $2\frac{1}{2}$ . 77. 4. 78.  $\frac{1}{2}$ ;  $\frac{2}{3}$ ;  $\frac{3}{4}$ ;  $\frac{1}{2}$ ;  $\frac{1}{4}$ ;  $\frac{1}{2}$ . 79.  $\frac{1}{2}$ ,  $\frac{1}{3}$ ,  $\frac{1}{4}$ ;  $\frac{1}{5}$ ,  $\frac{1}{6}$ ,  
 $\frac{1}{8}$ ;  $\frac{1}{10}$ ,  $\frac{1}{12}$ ,  $\frac{1}{16}$ ;  $\frac{1}{20}$ ,  $\frac{1}{24}$ ,  $\frac{1}{32}$ . 80. .375; 37 $\frac{1}{2}$ %. 81.  $\frac{1}{4}$ . 82.  $\frac{1}{4}$ . 83. .66 $\frac{1}{2}$ ;  
66 $\frac{1}{2}$ %. 84.  $\frac{3}{4}$ . 85.  $\frac{3}{4}$ . 86. 83 $\frac{1}{2}$ ; 83 $\frac{1}{2}$ %. 87.  $\frac{1}{2}$ . 88.  $\frac{1}{2}$ . 89. .1875;  
18 $\frac{3}{4}$ %. 90.  $5\frac{1}{2}$ . 91. 1 $\frac{1}{2}$ . 92. 288 in. 93. 12 qt. 94. 80 oz. 95. 72  
doz. 96. 720 sq. in. 97. 2 yd. 98. 8 pk. 99. 54 in. 100. 7920 ft.  
101. 44 oz. 102. \$6. 103. \$20. 104. \$9. 105. \$12. 106. \$10.  
107. \$14. 108. \$8. 109. \$15. 110. 10 yd. 111. 40 yd.  
112.  $5\frac{1}{2}$  yd. 113. 13 $\frac{1}{2}$  yd. 114. 192 yd. 115. 99 yd. 116. 16 yd.  
117. 50 yd.

Page 84. — 118. 10. 119. 21. 120. 30. 121. \$20. 122. \$31.  
123. \$40. 124. 4050. 125. 8075. 126. 11,100. 127. \$5. 128. \$30.  
129. \$20. 130. \$100. 131. 50 % gain. 132. 50 % loss. 133. 10 %  
loss. 134. 12 $\frac{1}{2}$  % gain. 135. \$90; \$810. 136. \$20; \$140.  
137. \$100; \$400. 138. \$300; \$900. 139. \$130; \$270. 140. \$2200;  
\$3800. 141. \$10. 142. \$100. 143. \$50. 144. \$15. 145. \$60;  
\$560. 146. \$97.50; \$747.50. 147. \$116; \$841. 148. \$70; \$1070.  
149. \$1050; \$8050. 150. \$1700; \$10,200. 151. \$775.83; \$10,275.83.  
152. \$891; \$9691.

Page 87. — 3. \$11.38. 4. \$25.85. 5. \$4.04. 6. \$445.59.  
7. \$104.04. 8. \$157.14.

Page 88. — 9. \$765.46. 10. \$61.20. 11. \$206.04. 12. \$154.52.  
13. \$885.93. 14. \$1206. 15. \$.48. 16. \$80.52. 17. \$1052.50.

HAM. ESS. AR. ***

Page 90.—1. \$.50. 2. \$1. 3. \$1.20. 4. \$1.60. 5. \$2.10.  
6. \$2.88. 9. \$60.10. 10. \$.40.

Page 91.—11. \$12.24. 12. \$.51. 13. \$.6.25. 14. \$.2.50; \$.12.50.  
15. \$25.50. 16. 31 certificates.

Page 95.—2. \$41. 3. \$240. 4. .003 $\frac{1}{2}$ . 5. \$44,252,705;  
\$31,535,462.81; \$16,447,908.05; \$9,955,312.77; \$11,398,111.72;  
\$1,607,690.26; \$3,112,323.45; \$3,442,106.07; \$7,110,937.69;  
\$2,349,701.15; \$1,277,907.64; \$1,071,793.51; \$1,484,021.78; \$1,030,570.68;  
\$288,559.79; \$69,749,023.62. 7. .003. 8. \$82.30. 9. \$74.76.

Page 96.—10. .008. 11. \$.65.60. 12. \$.21.75. 13. \$.95.80.  
14. \$4.79. 15. \$176. 16. \$110. 17. 24.4%; 18 $\frac{1}{2}$ %; 30.6%;  
12.8%; 5%.

Page 97.—18. \$186,300. 19. .018 $\frac{1}{3}$ ; \$379.97. 20. .0007 $\frac{1}{3}$ .  
21. .00045. 22. \$3520; \$10,120; \$14,520. 23. 5 $\frac{1}{2}$ %; 21 $\frac{1}{2}$ %; 26 $\frac{1}{2}$ %.  
24. 53 $\frac{2}{3}$ %.

Page 98.—25. 69.3%. 26. 97.6%. 27. \$67,165; \$65,835.  
28. 4.8 mills. 29. 59.4%; 4.9%; 4.5%. 30. .6 of a mill.  
31. \$58,938.50. 32. \$12,204.85.

Page 99.—1. 8.6%; 3.4%; 4.2%; 76.8%; 6.9%. 2. 7.7%.  
3. 1.3%. 4. 49.9%; 50.1%.

Page 100.—1. \$2000.

Page 101.—2. \$200. 3. \$342.80. 4. \$477. 5. \$6000. 6. \$460.  
7. \$1627.50. 8. \$1875. 9. \$475. 10. \$927.50. 11. \$60.  
12. \$1250. 13. \$330. 14. \$2687.50. 15. 12,000 lb. 16. \$1920.  
17. \$3.96 $\frac{1}{4}$ . 18. \$11,147.25. 19. \$2160.

Page 103.—2. \$253.75. 3. \$138. 4. \$256.50. 5. \$140.  
6. \$708.75. 7. \$208.75. 8. \$72. 9. \$428.75. 10. \$35.55.  
11. \$402. 12. \$195. 13. \$78.30. 14.  $\frac{2}{3}$ %; \$24. 15. \$58.50.  
16. 2 $\frac{1}{2}$ %; \$2.50. 17.  $\frac{1}{4}$ %.

Page 104.—18.  $\frac{7}{8}$ %. 19. 1 $\frac{1}{2}$ %. 20. \$53.25. 21.  $\frac{1}{2}$ %.  
22. 1 $\frac{1}{2}$ %. 23. \$42. 24. \$210; \$3290. 25. \$17,415; \$9585.  
26. \$18,000; \$21,600; \$32,400; \$36,000.

Page 106.—1. \$119.80. 2. 33.8%. 3. 48.1%. 4. \$821.60.  
5. \$268.45. 6. 45 yr. 7. \$800.40. 8. \$450.55. 9. \$528.

Page 108.—16. 960 tiles.

Page 109.—1. 72 pieces. 2. 21 pieces; 10 in. wasted. 3. 36  
blotters. 4. 60 patterns. 5. 10 book covers. 6. 50 rectangles.  
7. 40 designs. 8. 12 designs. 9. 12 holders; 12 holders.

Page 112.—8. 11 hooks. 9. 20 sq. in.; 60 sq. in. 10. 49 $\frac{1}{2}$  sq. in.

Page 113.—11. 16 in. 12. 61 sq. in. 14. 51 in.

Page 114.—15. 17 $\frac{1}{3}$  sq. ft. 16. 192 books; 144 books. 17. 69 in.  
18. 24 $\frac{1}{2}$  sq. ft. 19.  $\frac{1}{4}$  in. 20. 24 $\frac{1}{2}$  sq. ft.; 45 sq. ft. 21. 24 blocks.

Page 115.—22. 4 ft. 23. 5954 sq. ft. 24. 50 in. 25.  $12\frac{5}{8}$  sq. ft.

Page 117.—4. 5 bd. ft. 5.  $13\frac{1}{2}$  bd. ft. 6.  $22\frac{1}{2}$  bd. ft. 7. 120 bd. ft.  
8. 200 bd. ft. 9. 1200 bd. ft. 11. 8 bd. ft. 12. 40 bd. ft.  
13.  $18\frac{1}{2}$  bd. ft. 14. 18 bd. ft. 15. 30 bd. ft. 16.  $37\frac{1}{2}$  bd. ft.

Page 118.—17. \$383.34; \$455. 18. \$79.71; \$67.23. 19. \$855.  
20. \$99. 21. \$26.40. 22. \$84.48. 23. \$1126.40. 24. \$308.  
25. \$422.40. 26. \$140.80. 27. \$132. 28. \$704. 29. \$1848.  
30. \$770. 31. \$105.60. 32. \$1466.67. 33. \$1601.60. 34. \$2112.  
35. \$616. 36. \$316.80. 37. \$880. 38. \$1056. 39. \$70.40.  
40. \$79.20. 41. \$66.

Page 119.—42. \$72. 43. \$181. 44. \$131. 45. 8'' by 12'';  
96 sq. in. 46. 11''. 47.  $6\frac{1}{2}$ '. 48. 37''. 49.  $37\frac{1}{3}$  bd. ft., or 38 bd. ft.  
50. \$16. 51. \$16.

Page 120.—1. 16 ft. = 1 in.

Page 121.—4. 50 ft.; 2 ft. 5. 16 ft. 6. 3700 sq. ft. 8. \$164.45.

Page 125.—1. 48 ft. 2.  $80\frac{1}{2}$  ft. at widest end; 76 ft. at narrowest  
end. 3. \$8.10.

Page 126.—4. \$16.05. 5. \$14.72. 6. \$2.99. 7.  $12'' \times 16''$ .  
8.  $8'' \times 12''$ . 9.  $8'' \times 14''$ . 10.  $8'' \times 12''$ . 11. \$7.92; \$396.  
12. \$1.16 $\frac{1}{2}$ . 13. \$1.56. 14. \$88.08.

Page 127.—4. 84 %.

Page 128.—9. 1917; 1917. 10. 1910 to 1911. 11. 1916 to 1917.  
12. 150 %.

Page 129.—13. 150 %; 180 %; 250 %; 500 %. 14. 120 %; 158.3 %;  
162.6 %. 15. 418 %; 1391.5 %. 16. Wages, \$7,015,586; bonds,  
\$567,798.40; interest, \$907,658.50; sites, etc., \$2,384,480.30; rent, etc.,  
\$2,778,476.80.

Page 131.—24. Between 1900 to 1910. 25. 1810 to 1820; 1820 to  
1830; 1830 to 1840.

Page 132.—1. \$6.60. 3. \$8.10. 4. \$5.50. 5. \$3.50. 6. \$4.80.  
7. \$5.60. 8. \$5.20. 9. \$3.20.

Page 133.—1. (a) 5 strips; 6 strips; 7 strips; 8 strips; 5 strips;  
(b) 7 strips; 8 strips; 9 strips; 11 strips; 6 strips. 3. Lengthwise; 40 yd.  
4. \$42. 5. 35 yd. 6. 44 yd. 7. 45 yd. 8. 42 yd. 9. 24 yd.  
10. 29 yd. 11. \$7.20.

Page 134.—2. \$93.34. 3. \$26.32. 4. 96 bundles.

Page 135.—5. \$103.86. 6. \$395.22. 7. \$231.23.

1. \$206.40. 2. 12,960 tiles.

Page 136.—3. 40 sq. in. 4. 360 slates. 5. 240 slates; 450 lb.  
6. 5760 slates; \$120. 7. 157 bunches; \$157. 8. \$126. 9. \$147.  
10. 30 squares.

**Page 139.**—1. 3 times; set backward 1 hr. at each time belt; set forward 1 hr. at each time belt. 2. 1 P.M.; 11 A.M.; 10 A.M. 3. 8 A.M.; 11 A.M.; 10 A.M. 4. 2 A.M.; 1 A.M.; 3 A.M. 5. 7 A.M.; 6 A.M.; 5 A.M. 6. 2 P.M.; 1 P.M.; noon. 7. 4.30 P.M.; 1.30 P.M.; 3.30 P.M.; 2.30 P.M. 8. 7.15 A.M.; 7.15 A.M.; 4.15 A.M. 9. 1 A.M.; 2 A.M.; 3 A.M. 10. 20 min. 11. 3 hr. 12. 10 A.M. 13. 2.45 A.M. 14. 9 A.M.; 8 A.M.; 6 A.M.

**Page 141.**—1. 5. 2. .25. 3. 12. 4.  $\frac{1}{4}$ . 5. 8. 6. 4. 7.  $\frac{1}{15}$ . 8.  $\frac{1}{4}$ . 9. 100. 10. 3. 11. 6. 12. 320.

**Page 142.**—3.  $18\frac{1}{2}$ . 4. 15. 5. 10. 6. 5. 7. 5. 8. 10. 9.  $\frac{1}{2}$ . 10. .5. 11. 2.5. 12. 90. 14. \$18. 15. \$2.04. 16. 30 da. 17. 50 da.

**Page 143.**—18. \$2. 19. \$1921.88. 20. Smaller can. 21. 9 oz. 22.  $41\frac{1}{2}$  mi.

2. \$100; \$40; \$20. 3. \$5200; \$10,400.

**Page 144.**—1. 4450 ears. 2. \$92.71. 3. 33 doz. 4. \$16.

**Page 145.**—5. \$6.75. 6. \$8.55. 7. \$12. 8. \$29.35. 9. \$1.50. 10. \$5.50. 11. \$12.48. 12. \$10.70. 13. \$144.14.

**Page 146.**—14. 20 kernels. 15.  $129\frac{7}{17}$  bu. 16. 930 %. 17. 3¢; 597.8 %. 18.  $398\frac{1}{2}$  %. 19. 474 plants. 20. \$22.91. 21. 42.3 %. 22. \$12.91; 32.3 %. 23. \$2079.08. 24. \$1171.58.

**Page 147.**—1.  $25^\circ$ . 2.  $22^\circ$ . 3.  $22^\circ$ ;  $42^\circ$ . 4.  $80^\circ$ . 5.  $150^\circ$ . 6.  $26\frac{1}{2}^\circ$ . 7.  $14^\circ$ . 8.  $3\frac{1}{2}^\circ$ . 9.  $2^\circ$ . 10.  $27\frac{1}{2}^\circ$ . 11.  $32^\circ$ . 12.  $32^\circ$ .

**Page 148.**—1. \$5.56. 2. \$2.16. 3. \$3.56. 4. 418 K.W.H.; \$5.28. 5. \$206.35. 6. \$8.48; \$5.53.

**Page 149.**—1. \$31.92. 2. \$394. 3. 8.4 lb.; 8.17 lb.; 8.4672 lb.; 8.16 lb. 4. \$682.50. 5. \$190. 6. 2,310,000 lb.

**Page 150.**—1. \$1750; \$5700; \$3950. 2. 11.6 %.

**Page 151.**—1. Jan.,  $50\frac{1}{2}$  doz., \$25.33 $\frac{1}{2}$ ; Feb.,  $56\frac{1}{2}$  doz., \$24.75; Mar.,  $64\frac{1}{2}$  doz., \$23.22; Apr.,  $52\frac{1}{2}$  doz., \$17.70 $\frac{1}{2}$ ; May,  $42\frac{1}{2}$  doz., \$15.02 $\frac{1}{2}$ ; June,  $43\frac{1}{2}$  doz., \$16.18 $\frac{1}{2}$ ; July,  $44\frac{1}{2}$  doz., \$17.70; Aug.,  $41\frac{1}{2}$  doz., \$18.78 $\frac{1}{2}$ ; Sept.,  $32\frac{1}{2}$  doz., \$15.72; Oct.,  $25\frac{1}{2}$  doz., \$13.42 $\frac{1}{2}$ ; Nov.,  $46\frac{1}{2}$  doz., \$28.10; Dec., 50 doz., \$26. 2. 6613;  $551\frac{1}{17}$  doz.; \$241.95 $\frac{1}{17}$ , or \$241.96. 3. \$2.50. 4. \$141.96. 5. \$3.55. 6. 120.48 eggs; \$4.87. 7. \$3.66. 8. 302.5 %.

**Page 152.**—1. \$8.56. 2. 16.5 %; 48.1 %;  $3\frac{1}{2}$  %; 15 %; 5 %; 3.6 %. 3. \$432; \$288; \$144; \$216; \$144; saved, \$216. 4. 17.5 %; 29.2 %; 10 %; 18 %; 20 %; 5.3 %. 5. Family A: \$252; \$151.20; \$100.80; \$117.60; \$126; \$42; \$50.40. Family B: \$319.20; \$239.40; \$102.60; \$182.40; \$205.20; \$22.80; \$68.40. Family C: \$450; \$324; \$180; \$270; \$360; \$144; \$72. Family D: 30 %; 20 %; 10 %; 12.3 %; 20 %; 3.8 %; 3.8 %. Family E: 25 %; 18 %; 10 %; 14 %; 20 %; 3 %; 10 %.

**Page 153.**—1. 1078 lb.; \$349.78. 2. 9.3 %; 5.6 %; 15.6 %; 3.3 %; 8.9 %; 2.4 %; 2.2 %; 27.8 %; 4.5 %; 20.4 %. 3. \$2.75; \$7.20. 4. \$20.57.

Page 154.—1. \$4.04; \$.96. 2. \$12.16; \$.84. 3. \$25.75; \$4.25.  
4. \$8.02; \$1.98. 5. \$4.48; \$.52. 6. \$2.33; \$.67. 7. \$10.43; \$4.57.

Page 156.—1. 1,940,220. 2. \$54,912.60. 3. 2836.8206. 4. 1471 $\frac{1}{2}$ .  
5. 1087 $\frac{1}{2}$ . 6. 1569 $\frac{1}{2}$ . 7. 5673.22. 8. 1664.322. 9. 10,864.215.  
10. 592 $\frac{3}{4}$ . 11. 153 $\frac{1}{2}$ . 12. 197 $\frac{1}{2}$ . 13. .4428186. 14. 13,355.475842.  
15. 2517.4989. 16.  $\frac{2}{3}$ . 17.  $\frac{1}{2}$ . 18.  $\frac{1}{10}$ . 19.  $\frac{1}{2}$ . 20. 9 $\frac{1}{2}$ .  
21. 21 $\frac{1}{5}$ . 22. 23 $\frac{2}{3}$ . 23. 32. 24. 34,624 $\frac{1}{2}$ . 25. 7.8. 26.  $\frac{1}{10}$ .  
27. 1 $\frac{1}{2}$ . 28. 3 $\frac{1}{2}$ .

Page 157.—29. 120. 30. 168. 31. 300 gal. 32. 710 mi.  
33. 2996 cu. in. 34. 2130 A. 35. 33 $\frac{1}{2}$  %. 36. 25 %. 37. 12 $\frac{1}{2}$  %.  
38. 18 $\frac{1}{2}$  %. 39. \$60. 40. \$100. 41. \$2.55. 42. \$16.75.  
43. Gain, 20 %. 44. Gain, 66 $\frac{2}{3}$  %. 45. Loss, 50 %. 46. Loss, 33 $\frac{1}{3}$  %.  
47. \$40; \$360. 48. \$30; \$570. 49. \$101.50; \$598.50. 50. \$103;  
\$297. 51. \$60. 52. \$112.50. 53. \$2400. 54. \$266.67.  
55. \$115. 56. \$340. 57. \$37.50. 58. \$82.50. 59. \$96.25.  
60. \$58.50.

Page 158.—61. .0002. 62. .00225. 63. 4 mills. 64. 6 mills.  
65. \$600. 66. \$900. 67. \$625. 68. \$12.50. 69. \$40.50; \$490.50.  
70. \$36; \$356. 71. \$54.17; \$1054.17. 72. \$198; \$2398.  
73. \$20.25. 74. \$42. 75. \$117. 76. \$356. 77. \$7.50. 78. \$20.  
79. \$333.34. 80. \$22.50. 81. \$6.30. 82. \$5.60. 83. \$5.25  
84. \$2.80. 85. 33 $\frac{1}{2}$  yd. 86. 32 yd. 87. 28 yd. 88. 13 $\frac{1}{2}$  yd  
89.  $\frac{1}{2}$ . 90. 8. 91. 10. 92. 3 $\frac{1}{2}$ . 93. 5. 94. 15.

Page 162.—4. \$1223.70. 5. \$359.07.

Page 163.—7. Amount, \$576.18.

Page 166.—6. \$254.25.

Page 167.—9. \$25. 11. \$255. 12. \$530. 13. \$388.50.  
14. \$129.38.

Page 170.—2. Sept. 3. 3. Nov. 3. 4. Apr. 2. 5. Apr. 2.  
6. June 30. 8. July 10; 25 da. 9. Nov. 10; 41 da. 10. Sept. 1; 30  
da. 11. July 23; 51 da. 12. Sept. 3; 55 da.  
2. Nov. 8, 1919; \$1.50; \$98.50. 3. Aug. 12, 1920; \$5; \$495.  
4. Oct. 2, 1919; \$12.50; \$987.50. 5. May 8, 1920; \$12.50; \$612.50.  
6. May 4, 1920; \$15; \$1985. 7. July 7, 1920; \$15; \$1485.

Page 171.—8. Oct. 1, 1920; \$5; \$1195. 9. Dec. 31, 1920; \$12.50;  
\$2487.50. 10. June 3, 1920; \$68.75; \$4931.25. 11. \$172.55.  
12. \$148.67. 13. \$123.29. 14. \$204.10.

Page 172.—2. \$580.

Page 173.—2. \$553.49. 3. \$874.39.

Page 175.—1. Incomes: \$85; \$80; \$100; \$120. 2. \$150.  
3. \$260. 5. 2.9 %. 6. 17.9 %. 7. 21 %. 8. \$350.

Page 176.—9. 8 $\frac{1}{2}$  %. 10. Loss, \$124.75. 11. \$1820. 12. \$1180.  
13. \$267.50. 14. Profit, \$74. 15. (a) \$252.28; (b) \$360; (c) \$1570.

Page 177.—16. 10 %. 17. 6 $\frac{1}{2}$  %. 18. \$27.92. 19. \$565.  
20. Mortgage; \$184.60.

Page 178.—21. \$1853. 22. 7.4%. 23. 8.4%. 24. \$1800.  
25. 6%. 26. 136%.

Page 180.—1. \$2502.50.

Page 181.—\$.05.

Page 182.—1. (1) \$1.25; (2) \$2.65; (3) \$1.85. 2. (1) \$1.15;  
(2) \$2.55; (3) \$1.75. 3. (1) \$.70; (2) \$2.10; (3) \$1.30.

Page 184.—4. \$2.50. 5. \$.22. 6. \$4950. 7. \$3678.15.

Page 185.—1. £2 7d., 51.25 francs, 41.25 marks; £10 2s. 11d., 256.25 francs, 206.25 marks.

Page 187.—1. 234 lb.; 61.2 lb.; 52.25 lb.; 184 lb. 2. 39 T.  
3. 235 T. 4. \$12.25. 5. \$23.16. 6. \$24.33. 7. 300 lb. each.

Page 188.—8. \$2.60. 9. \$708. 10. \$1140. 11. \$331.24.  
12. \$1. 13. \$1.28 $\frac{1}{2}$ .

Page 189.—14. \$45.84. 15. \$3.17. 16. \$2328. 17. 45.2%.  
18. \$80. 19. \$3225. 20. \$328.

Page 190.—21. \$70 profit. 22. \$522. 23. 67.4%. 24. \$150.85.  
25. \$190.08. 26. \$79.52. 27. 8,435,084,131 lb. 28. 2,383,414,080 lb.  
29. 34.7%.

Page 191.—30. 78.6%; 76.8%. 31. 25.3%; 23.9%. 32. 25%.  
33. 32.6%; 15.9%; 9.9%; 8.1%; 7.2%.

Page 192.—34. 48.9%; 30.4%; 25%; 22.1%. 35. \$7680.  
36. \$1536. 37. 43%. 38. 40%. 39. 42.9%.

Page 193.—40. 66 $\frac{1}{2}$ %. 41. 31 $\frac{1}{2}$ %. 42. 21%. 43. 100%.  
44. 106.3%. 45. 14.4%.

Page 194.—1. 33 $\frac{1}{2}$ %. 2. \$133.33 $\frac{1}{2}$ . 3. \$1204. 4. \$23,520.  
5. \$691.20. 6. 10%.

Page 195.—1. \$960. 2. \$1242. 3. \$2528.40.

Page 196.—4. \$2343.75. 5. 180%. 6. 400%. 7. 26 $\frac{1}{2}$ %.  
8. 400%. 9. \$1300.

Page 197.—1. 7,036,337; \$4,079,332,000; \$579.75.

Page 198.—2. 268,491; 275,791; 7300. 3. 2.7%. 4. \$4,362,710,000.  
5. 23.7%. 6. \$20,672,052,000; \$24,246,435,000. 7. 17.3%. 8. 9.6%.  
9. 12.8%. 10. 25.5%. 11. 12.7%. 12. 21.9%. 13. 11.1%.  
14. 28.3%. 15. 20.2%. 16. 26.6%.

Page 199.—20. 975; 1124; \$464,249,813; \$507,166,710.  
21. \$42,916,897. 22. 11.8% dec.; 3.1% dec.; 2.9% dec.; 15.5% inc.;  
55.6% dec.

2. \$664.68. 3. \$875.70.

Page 200.—4. \$108.42. 5. 15.6%. 6. \$11,020. 7. \$328.51.  
8. \$1.93. 9. \$39.24. 10. \$22.59. 11. 6.8%. 12. \$132.93.  
13. \$10.04. 14. \$18.95.



Page 201.—15. \$44.54. 16. \$424.25.

1. \$7125. 2. 168 cars. 3. \$53,125. 4. \$8046.88. 5. 47.5 %.

Page 202.—6. 73,767.12 lb.; \$118.03. 7. \$103.40. 8. \$44.26.  
9. 480 lb.; \$424.10. 10. \$304.29. 11. \$128,409.60. 12. \$1120.81.  
13. \$97.28. 14. \$90.

Page 208.—1. 72. 2. 84. 3. 240. 4. 350. 5. 25. 6. 48.  
7. 32. 8. 30. 9. 60. 10. 40. 11. 76. 12. 138. 13. 170.  
14. 180. 15. 144. 16. 28. 17. 200. 18. 256. 19. 46. 20. 134.  
21. 66½. 22. 96. 23. 35. 24. 260. 25. 61. 26. 33.

Page 211.—3. 4. 4. 8. 5. 12. 6. 7. 8. 13. 9. 30. 10. 40.  
11. 115. 12. 7. 13. 8. 14. 8. 15. 13. 16. 30. 17. 14.  
18. 18. 19. 25. 20. 30. 21. 25.

Page 212.—3. 5. 4. 8. 5. 55. 6. 6. 7. 9. 8. 7. 9. 30.  
10. 7. 11. 7. 12. 6. 13. 12. 14. 9. 15. 10. 16. 5. 17. 8.  
18. 9. 19. 10. 20. 7.

Page 214.—1. 10. 2. 48. 3. 15. 4. 7. 5. 36. 6. 6.  
7. 100. 8. 30. 9. 60. 10. 6. 11. 5. 12. 3. 13. 5. 14. 6.  
15. 12. 16. 12. 17. 27. 18. 33. 19. 13. 20. 23. 21. 17.  
22. 5. 24. 10. 25. 15. 26. 11. 27. 8. 28. 5. 29. 3. 30. 6.  
31. 9. 32. 3.

Page 215.—1. 60. 2. 52. 3. 90. 4. 4. 5. 60. 6. 9. 7. 9.  
8. 4. 9. 25.

Page 216.—12. 12. 13. 36. 14. 20. 15. 30. 16. 12. 17. 54.  
18. 96. 19. 12. 20. 42. 21. 12. 22. 16. 23. 7. 24. 12.  
25. 16. 26. 12. 27. 6. 28. 12. 29. 6. 30. 12. 31. 20.  
32. 36. 33. 15. 34. 6.

Page 217.—35. Page 142. (2) 24. (3) 18½. (4) 15. (5) 10.  
(6) 5. (7) 5. (8) 10. (9) ½. (10) .5. (11) 2.5. (12) 90.  
2. 25. 3. \$300; \$900. 4. 75 A.; 150 A.; 225 A. 5. \$900;  
\$1800; \$3600. 6. 72; 216. 7. 125; 500. 8. Martha, \$5; John,  
\$2.50.

Page 218.—9. 128; 32. 10. 20°; 40°; 120°. 11. 28. 14. 57;  
38. 15. 44. 16. 240 pupils. 17. \$1800. 18. \$100.

Page 219.—19. 88; 33. 20. 49. 21. 25 games. 22. 8; 2.  
23. \$2000. 24. 6 in.; 2 in. 25. 40; 80. 26. Horse, \$300; wagon,  
\$200. 27. Spectators, 3500; skaters, 1400. 28. 4 in.; 8 in.; 12 in.  
29. Hay, 3000 lb.; wagon, 1500 lb. 30. 30; 60; 180. 31. 550 pupils.

Page 220.—32. 15; 10. 33. 90 A.; 80 A.; 60 A. 34. 90 rd.  
35. 80 rd.; 160 rd. 36. \$150; \$300; \$100. 37. \$60. 38. \$200.  
39. \$3360. 40. Cow, \$80; horse, \$320. 41. \$1000. 42. 5 %.  
43. 3 yr. 44. \$2.40.

Page 221.—2. Arthur Bruce's time, 8 hr., 7½ hr., 6½ hr., 8 hr., 8 hr.,  
7½ hr., total 45½ hr.; wages, \$27.15. 3. James Mason's time, 8 hr., 8 hr.,  
7½ hr., 8 hr., 7 hr., 6½ hr., total 45½ hr.; wages, \$27.15. 4. David Easton's  
time, 8 hr., 7 hr., 8 hr., 8 hr., 8 hr., 7 hr., total, 46 hr.; wages, \$25.30.

Page 222.—1. \$46,200. 2. \$644,000,000. 3. \$.0068. 4. \$79.20.  
5. \$13,260. 6. \$3,907,382,572. 7. 10 % ; 20 % ; 60 % ; 75 %.  
8. 80 % ; 93 $\frac{1}{2}$  %.

Page 223.—1. \$352. 2. 22 $\frac{1}{2}$  mi. ; 1 $\frac{1}{4}$   $\phi$ . 3. 1 $\frac{3}{4}$   $\phi$ . 4. \$12.44.  
5. \$9.16. 6. 36.8 %. 7. \$.004. 8. 8724 mi.

Page 224.—1. \$32,000 ; \$42.11. 2. 64 %. 3. 60 % ; 166 $\frac{2}{3}$  %.  
4. \$1365. 5. .00062 %. 6. .002 %. 7. .062 %. 8. .57 $\frac{1}{2}$  %.  
9. 20 % ; 25 % ; 26 $\frac{1}{2}$  % ; 21.1 % ; 17.4 % ; 3.7 % ; 7 $\frac{1}{4}$  % ; 16 $\frac{1}{2}$  % ; 14 $\frac{1}{2}$  %.

Page 226.—1. 25,857,048. 2. \$397,338.66. 3. 22,602.3889.  
4. 1143 $\frac{1}{3}$ . 5. 1265 $\frac{1}{3}$ . 6. 1380 $\frac{2}{3}$ . 7. 207,102. 8. 858 $\frac{1}{2}$ .  
9. 3876.536. 10. 1732 $\frac{1}{2}$ . 11. 3983.216. 12. 1778 $\frac{1}{10}$ .  
13. \$5775.3375. 14. 50,743.73351. 15. 19,291.9882958. 16. 1 $\frac{1}{10}$ .  
17. 291 $\frac{1}{4}$ . 18.  $\frac{577}{100}$ . 19. 307 $\frac{1}{4}$ . 20.  $\frac{27}{100}$ . 21. 495 $\frac{1}{10}$ .  
22. 967.347. 23. 750.142. 24. 2. 25. \$93.03. 26. \$135.42.  
27. 1 $\frac{1}{2}$ . 28. 4.74. 29. 7.19. 30. 1 $\frac{1}{2}$ .

Page 227.—31. 330. 32. \$320. 33. 960. 34. 2296.8. 35. 1100.  
36. 690. 37. 5 %. 38. 3 $\frac{1}{2}$  %. 39. 25  $\phi$ . 40. 33 $\frac{1}{2}$  %. 41. 625 %.  
42. 2000 %. 43. \$96.18. 44. \$268.65. 45. \$780. 46. \$874.80.  
47. \$1.05 ; \$4.20. 48. \$2.74 ; \$8.22. 49. \$384.25 ; \$2265.75.  
50. \$1035 ; \$2565. 51. \$110.15. 52. \$48.08. 53. \$600. 54. \$900.  
55. \$45. 56. \$107.30. 57. \$56.49. 58. \$152.25. 59. 1 mill.  
60. 2 mills. 61. .75 of a mill. 62. .3 of a mill. 63. \$5600.  
64. \$625.

Page 228.—65. \$198.75 ; \$2848.75. 66. \$368.55 ; \$4463.55.  
67. \$875 ; \$13,375. 68. \$2003.43 ; \$18,247.43. 69. \$60. 70. \$142.45.  
71. \$590. 72. \$1740. 73. June 1 ; 60 da. ; \$36 ; \$3564. 74. June  
4 ; 30 da. ; \$22.50 ; \$5377.50. 75. Nov. 1 ; 150 da. ; \$222.50 ; \$8677.50.  
76. Aug. 6 ; 30 da. ; \$30 ; \$7170. 77. Sept. 6 ; 30 da. ; \$15 ; \$2985.  
78. Jan. 8 ; 60 da. ; \$24.20 ; \$2395.80. 79. \$2.53. 80. \$45.18.  
81. \$65.25. 82. \$50.95. 83. \$5.33. 84. \$22.87. 85. \$30.12.  
86. \$90.30. 87. \$16.25. 88. \$56.85. 89. 6. 90. 5. 91. 20.  
92. 35. 93. 58. 94. 10. 95. 22. 96. 40.

Page 233.—2. \$26,824. 3. \$1638. 4. \$10,712.25. 5. \$11,741.25.

Page 234.—7. \$451.50. 8. \$15,030. 10. \$4448.75. 11. \$934.75.  
12. \$10,510.

Page 235.—1. \$175. 2. \$784. 3. \$500. 4. \$180. 5. \$250.  
6. \$586. 7. \$305. 8. \$249.20. 9. \$799. 10. \$945. 11. \$220.80.

Page 237.—2. \$2613.75. 3. \$18,100. 4. \$6175. 5. \$501.  
6. \$501.

Page 238.—8. \$17,320. 9. \$21,735. 10. \$7085. 11. \$75.  
12. \$2720. 13. \$95. 15. \$500. 16. \$180. 17. \$600. 18. \$900.  
19. \$200. 20. \$17.50. 21. \$6. 22. \$1. 23. \$4.25. 24. \$8.50.  
25. \$42.50. 26. \$21.25.

Page 240.—1. 45°. 2. 30°. 3. 19°. 4. 80°. 5. 42° 15'.  
6. 34° 20'.

# ANSWERS

XV

**Page 241.** — 2. 30 sq. in. 3. 48 sq. yd. 4. 27 sq. ft. 5. 35 sq. ft.  
6. 70 sq. ft. 7. 60 sq. ft.

**Page 242.** — 3. 140 sq. ft. 4. 180 sq. ft. 5. 60 sq. ft. 6. 196 sq. ft.  
7. 320 sq. ft.; 90 sq. ft. 8. 696 sq. rd.; 2504 sq. rd. 9. 44 sq. yd.;  
97½ sq. yd. 10. 180 sq. ft.; 660 sq. ft.

**Page 244.** — 2. 5 in. 3. 4 ft. 4. 13 ft. 5. 25 yd. 6. 15 ft.  
7. 1300 sq. rd.

**Page 246.** — 1. 266.5 sq. ft. 2. 144.9 sq. ft. 3. 2916 sq. yd.  
4. 33.75 sq. yd. 5. 517.5 sq. ft. 6. 945 sq. ft. 7. 27 sq. ft.  
8. 5886 sq. ft.

1. 52½ A. 2. 28½ A. 3. 75 A. 4. 8 ft. 5. 9 in. 6. 80 rd.

**Page 247.** — 2. 1050 sq. in. 3. 10 rd.

**Page 248.** — 5. 440 sq. ft. 6. 308 sq. ft.

**Page 249.** — 1. 47.124 ft. 2. 78.54 ft. 3. 188.496 ft. 4. 33.5104 ft.  
5. 89.27 ft. 6. 87.9648 yd. 7. 126.7112 ft. 8. 94.248 in.  
9. 82.7288 ft. 10. 4 ft. 11. 40 yd.

**Page 250.** — 1. 78.54 sq. rd. 2. 314.16 sq. rd. 3. 254.4696 sq. ft.  
4. 1017.8784 sq. ft. 5. 314.16 sq. in. 6. 1256.64 sq. in. 7. 5026.56 sq. rd.  
8. 490.875 sq. yd. 9. 11,309.76 sq. ft. 10. 78 sq. ft. 11. 3.14 sq. rd.  
12. 706.86 sq. in. 13. 962.11 sq. yd. 14. 314.16 sq. ft. 15. 78.54 sq. yd.  
16. 49,087.5 sq. ft. 17. 11,309.76 sq. yd. 18. 1134.11 sq. yd.  
19. \$50.27.

**Page 251.** — 1. 432 sq. ft. 2. 1000 sq. in. 3. 118 sq. ft. 4. 412 sq. ft.  
5. 170 sq. ft. 6. 334 sq. ft. 7. 96 sq. in. 8. 864 sq. in. 9. 24 sq. ft.  
10. 937½ sq. in. 11. 1176 sq. in. 12. 793½ sq. ft.

**Page 252.** — 2. 250 cu. ft. 3. 684 cu. ft. 4. 800 cu. ft. 5. 9 cu. ft.  
6. 4½ cu. ft. 7. 5 cu. yd. 8. 213½ loads. 9. 1728 cakes. 10. 448 cu. ft.  
11. 5 cords. 12. 22½ cords. 13. 64 boxes. 14. 22½ cords; \$41.63.  
15. 23½ cords; \$42.78. 16. 28½ cords; \$52.03.

**Page 253.** — 17. 18½ cords; \$34.69. 18. 106½ loads. 19. 56½ cords.  
20. 17. 21. 1417½ cu. in. 22. 111.475 cu. in. larger. 23. 126.6 cu. in.  
more. 24. 162½ cu. in. 25. 10,936½ cu. in. 26. 1595½ cu. in.  
27. Orange box; 1440 cu. in.

**Page 254.** — 28. 124½ cu. in.; 451½ cu. in. 29. 268½ loads.

**Page 255.** — 1. 753.984 sq. in. 2. 1413.72 sq. in. 3. 20.944 sq. ft.  
4. 8.3776 sq. ft. 5. 600 sq. in. 6. 312 sq. in. 7. 678.5856 sq. ft.  
8. 155.5092 sq. ft.

**Page 256.** — 1. 3180.87 cu. ft. 2. 14,726.25 cu. ft. 3. 100.5312 cu. ft.  
4. 6031.872 cu. ft. 5. 1568 cu. in. 6. 4950 cu. ft.

**Page 257.** — 7. 803.56 bu. 8. 520.70 bu. 9. 1157.13 bu.  
10. 867.84 bu. 11. 448.83 gal. 12. 4.9 bbl. 13. 6.7 bbl.  
14. 109,714½ gal.; 3482.99 bbl. 15. 1.27 hr. 16. 7500 lb.; 120 cu. ft.

**Page 258.** — 17. 1 T. 12 cwt. 88½ lb. 18. 29,687.5 lb. 19. 5714½ bbl.  
20. 672 bu. 21. 5½ T. 22. 598.44 gal. 23. 108,000 lb. 24. 1967.12 bu.  
25. 31½ T. 26. 7854 cu. ft.; 36.41 lb.

**Page 259.**—27. 2886.345 gal.; 3769.92 gal.; 4771.305 gal. 28. 183.6 gal.  
29. 159,048.5 gal. 30. 37.4 bbl. 31. 3578.47 gal. 32. 1507.96 cu. in.  
33. 84,828.2 lb. 34. 10.68 bbl. 35. 20 $\frac{1}{4}$  T. 36. 27.489 bbl., or  
27.5 bbl.

**Page 260.**—1. 169.6464 sq. ft. 2. 768 sq. ft.

**Page 261.**—3. 160 sq. ft. 4. \$80.17.

**Page 262.**—1. 201.0624 cu. in. 2. 1440 cu. in. 3. 3456 cu. in.  
4. 94.248 cu. ft.

1. 50 rd. 2. 15 ft. 3. 3280 tiles. 4. 400 sq. in.; 80 in. 5. 1944  
sq. in.; 5832 cu. in.

**Page 263.**—6. 918 boxes. 7. 216 cakes. 8. 312 sq. in.  
9. \$57,600. 10. \$800. 11. \$7168. 12. 1.32 ft. 13. 589,050 lb.  
14. 56 yd. 15. \$10,640; \$52,800.

**Page 264.**—16. 3320 sq. rd.; 371.12 sq. rd.; 4908.88 sq. rd. 17. 100  
revolutions. 18. \$35.47. 19. 345 sq. ft. 20. \$464.56. 21. \$424.96.  
22. 15 ft. 23. \$80.

**Page 265.**—24. \$666.67. 25. \$468. 26. 2714.3424 cu. ft.  
27. 960 blocks; 110,400 lb. 28. 17.952 bbl. 29. 6000 lb. 30. \$72.50.  
31. \$663.51. 32. \$67.50. 33. \$322.23. 34. \$167.68.

**Page 266.**—35. \$276; \$128.97. 36. 4 ft. 37. \$1036.80.  
38. 27.97 $\frac{1}{2}$  bbl. 39. 1000 sq. in. 40. 18,334.6 ft. 41. 9257 $\frac{1}{2}$  bu.  
42. 4.1888 sq. ft. 43. Flow through  $\frac{3}{4}$ -inch pipe is 2 $\frac{1}{4}$  times that through  
 $\frac{1}{4}$ -inch pipe.

**Page 268.**—1. 36; 49; 64; 81; 100; 144; 225. 2. 27; 64; 125;  
216; 343; 512; 729; 1000; 1728. 3. 900; 2500; 3600; 6400; 14,400.  
4. 8000; 27,000; 64,000; 125,000; 1,000,000. 5. 121; 169; 196; 1331;  
3375; 216,000. 6.  $\frac{25}{125}$ ;  $\frac{125}{15625}$ ;  $\frac{1}{125}$ ;  $\frac{125}{15625}$ ;  $\frac{1}{125}$ ;  $\frac{125}{15625}$ ;  $\frac{1}{125}$ . 7. .09; .0016; .0025;  
.36; .0036; .064; .000064; .216. 8. 289. 9. 256. 10. 324. 11. 484.  
12. 625. 13. 42.25. 14. 5625. 15. 2 $\frac{1}{4}$ . 16. 272 $\frac{1}{4}$ . 17. 361 sq. in.  
18. 576 sq. ft. 19. 1296 sq. yd. 20. 784 sq. ft. 21. 1225 sq. in.  
22. 72.25 sq. in. 23. 56.25 sq. yd. 24. 67.24 sq. yd. 25. 37.21 sq. mi.  
26. 2744 cu. in. 27. 42.875 cu. ft. 28. 59.319 cu. ft. 29. 74,088 cu. in.  
30. 857.375 cu. yd. 31. 421.875 cu. ft.

**Page 269.**—3. 11. 4. 12. 5.  $\frac{7}{8}$ . 6. 15. 7. 20. 8.  $\frac{4}{5}$ . 9. 25.  
10. 12. 11.  $\frac{4}{5}$ . 12. 30. 13. 14. 14. 20. 15. 11. 16. 30.  
17. .4. 18. 40. 19. 14. 20. 16. 21. 50. 22. 90.

**Page 270.**—2. 17. 3. 24. 4. 21. 5. 18. 6. 28. 7. 36.  
8. 16. 9. 48. 10. 42. 11. 24. 12. 56. 13. 18. 14. 72.  
15. 25. 16. 32. 17. 64.

**Page 273.**—5. 22. 6. 27. 7. 26. 8. 31. 9. 33. 10. 43.  
11. 51. 12. 63. 13.  $\frac{9}{16}$ . 14.  $\frac{14}{15}$ . 15.  $\frac{14}{15}$ . 16. .5. 17. .15.  
18. 2.1. 19. 2.5. 20. .25. 21. 49. 22. 73. 23. 34. 24. 66.  
25. 14.5. 26. 13.5. 27. 122. 28. 168. 29. 360. 30. 4.56.  
31. 9.84. 32. 13.875. 33. 23.25. 34. 56.5. 35. 75.125. 36. .92.  
37. .114. 38. .024. 39. .661. 40. 335.

**Page 277.**—5. 1.363 m.; 6.525 m. 7. 177.192 mi.

Page 278. — 8. 37.5 m. 9. 67.59 mi. 10. 6400 Km.

Page 280. — 2. \$72.90. 3. \$33.75. 4. 24 sq. m. 5. 24 steres.

Page 282. — 1. 937.5 l. 2. 188,496 l.; 188,496 T. 3. \$165.  
4. 3,000,000 l. 5. 7.2 Hl. 6. 9000 bottles.

Page 283. — 7. \$3860. 8. 45¢. 9. 1000 l. 10. 89.09 Kg.  
11. 1.529 cu. m. 12. 4434.1 Kg. 13. 169.16 m. 14. \$63.75.  
15. \$1650. 16. 600,000 tiles. 17. 810 cu. cm. 18. 1153.6 cu. cm.  
19. 140,400 T. 20. 4680 cu. m.

Page 284. — 1. 28.7 % inc. 2. 10.1 % inc. 3. 29.6 % inc.  
4. 32.9 % inc. 5. 17.1 % inc. 6. 21.9 % inc. 7. 18.6 % inc.  
8. 40.5 % inc. 9. 35.7 % inc. 10. 38.1 % inc. 11. 43.8 % inc.  
12. 30.6 % inc. 13. 1.1 % dec. 14. 6.9 % dec. 15. 3.9 % inc.  
16. 4.4 % inc. 17. 8.4 % inc. 18. 1.6 % dec. 19. 9 % inc.  
20. \$1098; \$480; \$579; \$139.50. 21. 286½ % inc.; 266½ % inc.

Page 285. — 1. \$40; \$84; \$40; \$1600; \$176; gain, \$22.27½ per acre.  
2. Gain, \$43.87½.

Page 286. — 1. \$840. 2. \$2349.50. 3. 12.2 %. 4. 13.6 %.  
5. 120.9 %. 6. \$2232.025. 7. \$258.45. 8. 33 %. 9. 100.02 %.

Page 287. — 1. \$.86½. 2. .7 %. 3. 1.05 A.; 238½ hr.  
4. \$158.93. 5. 13½ da., or 13 da. 1½ hr. 6. 37½ A. 7. 138½ bu.  
8. \$53.12.

Page 289. — 1. (a) \$18,078; (b) \$19,828; (c) \$16,078; (d) \$18,328;  
(e) \$2250. 2. (f) \$668; (g) \$300; (h) \$3218. 3. (i) \$18,953;  
(j) \$947.65; (k) \$1947.65. 4. \$1270.35. 5. 6.7 %. 6. 5.6 %.  
7. 1½ %. 8. 5 %. 9. \$3274.80.

Page 290. — 1. 3½ lb. 2. Wheat bread 1.092 oz. protein, 6.396 oz. carbohydrates, .192 oz. fat; rye bread 1.08 oz. protein, 6.384 oz. carbohydrates, .072 oz. fat. 3. 1.915 oz. protein, 4.307 oz. carbohydrates, 2.321 oz. fat.

Page 291. — 4. .031 lb.; .06 lb.; 195 calories. 5. Mutton contains .2481 oz. protein and .282 oz. fat more than egg. 6. .198 oz. protein, .24 oz. fat, .3 oz. carbohydrates. 7. Rye bread contains .068 lb. more protein, .005 lb. more fat, .348 lb. more carbohydrates. 8. Protein, 2.52 oz.; 2512.42 calories.

Page 292. — 1. Stock will yield greatest income. Order of safety: First Liberty bond; mortgage; preferred stock. 2. Mining stock, \$2000 cost, \$100 income; dry goods stock, \$7500 cost, \$525 income; savings bank, \$500 cost, \$20 income. 3. Liberty bonds, \$2000 cost, \$85 income; mortgage, \$5000 cost, \$250 income; State bonds, \$3000 cost, \$120 income. 4. 141.8 %. 5. 88.4 %; George. 6. \$390. 7. \$637.50; \$247.50.

Page 293. — 1. (a) \$86,000,000,000; (b) \$48,000,000,000; (c) \$134,000,000,000. 2. 6 %; 20.1 %; 18 %; 6.3 %; 15.7 %; 26.1 %; 9.7 %.  
3. (a) \$18,400,000,000; (b) \$79,000,000,000; (c) \$5,160,000,000; (d) \$50,000,000,000; (e) \$23,560,000,000; (f) \$129,000,000,000. 4. 400 %; 571.4 %; 369.2 %; 250 %; 521.7 %; 3004.3 %; 375.5 %. 5. 547.5 %.  
6. (a) 10.1 %; (b) 15.4 %; (c) 13.9 %; (d) 23.3 %.

**Page 295.** — 1. \$6579.89. 2. \$30,356.72. 3. \$40,043.77.  
4. 69,475.7487.

**Page 296.** — 5. 4,137,998. 6. 3,068,660. 7. 3,852,574. 8. \$19,556.88.  
9. \$55,906.51. 10. \$21,781.41. 11. 2697.503. 12. 205,7998.  
13. 3609.06. 14. 19,486,296. 15. 45,641,176. 16. 76,849,156.  
17. \$556,427.92. 18. \$310,064.50. 19. \$243,258.78. 20. \$35,307.48.  
21. \$22,213.17. 22. \$2153.88. 23. 85,502.932. 24. 2895.8208.  
25. 575.13488. 26. 50,070. 27. 3428. 28. \$173.57. 29. \$152.94.  
30. \$705.08. 31. 68.206. 32. 124.7. 33. 888.81. 34. 54.65. 35. 906.72.  
36. 2.27. 37. 601. 38. .022. 39. 33.3. 40. .004. 41. 3000.  
42. 1053 $\frac{1}{2}$ ; 85 $\frac{1}{2}$ . 43. 1030 $\frac{1}{10}$ ; 530 $\frac{1}{2}$ . 44. 1299 $\frac{1}{10}$ ; 700 $\frac{1}{10}$ . 45. 2605 $\frac{2}{100}$ ;  
762 $\frac{2}{100}$ .

**Page 297.** — 46. 37 $\frac{1}{2}$ ; 4 $\frac{1}{2}$ . 47. 87 $\frac{1}{2}$ ; 2 $\frac{1}{2}$ . 48. 175 $\frac{7}{10}$ ; 3 $\frac{1}{10}$ . 49. 583 $\frac{1}{2}$ ;  
4 $\frac{1}{2}$ . 50. 145 $\frac{1}{2}$ ; 8 $\frac{1}{2}$ . 51. 28 $\frac{1}{2}$ ;  $\frac{1}{2}$ . 52. 7140. 53. 4000. 54. \$11.99.  
55. \$38.44. 56. 12 $\frac{1}{2}$ %. 57. 2.8%. 58. 33 $\frac{1}{2}$ %. 59. 6%. 60. 300%.  
61. 160%. 62. \$70.05, profit. 63. \$101.39, profit. 64. \$2150, loss.  
65. \$1249, loss. 66. 66 $\frac{2}{3}$ %, profit. 67. 16 $\frac{1}{2}$ %, profit. 68. 20%, loss.  
69. 20%, loss. 70. \$5.10; \$7.65. 71. \$14.70; \$2.10. 72. \$325;  
\$675. 73. \$1290; \$1710. 74. \$1050; \$6050. 75. \$1343.85; \$7667.85.  
76. \$481.25; \$3981.25. 77. \$675; \$5175. 78. Aug. 1; 92 da.; \$70.28;  
\$5429.72. 79. Dec. 31; 30 da.; \$32; \$6368.

**Page 298.** — 80. \$10,880. 81. \$52,825. 82. \$4926.25. 83. \$1006.50.  
84. \$7572.50. 85. \$8407.50. 86. \$5017.50. 87. \$18,595. 88. \$5087.50;  
\$275. 89. \$906.25; \$45. 90. \$8450; \$400. 91. \$1942.50; \$100.  
92. 31.416 in. 93. 78.54 ft. 94. 28.2744 ft. 95. 65.9736 ft. 96. 50 sq. in.  
97. 320 sq. ft. 98. 201.0624 sq. ft. 99. 1963.5 sq. in. 100. 2250 cu. in.  
101. 2250 cu. in. 102. 23. 103. 29. 104. 83. 105. 96. 106. 102.  
107. 113.

**Page 301.** — 1. Latter, \$.19 cheaper. 2. Latter, \$.01 $\frac{1}{4}$  per pound.  
3. \$9.72. 4. 400,000,000 bu. 5. 1200 times. 6. \$1800; \$2520.  
7. First; 6 sq. ft. 8. \$840. 9. 132 mi. 10. \$600; \$400; \$300.

**Page 302.** — 11. 319,000,000 lb. 12. 695,200,000 lb. 13. 564,200,000 lb.  
14. 1,528,100,000 lb. 15. 76 hr. 16. 2 $\frac{1}{2}$  A. 17. 324 cu. ft.;  
every 10 $\frac{1}{2}$  min. 18. 4 times. 19. 640 bu. 20. \$107.49. 21. 38 mi.  
22. 2085 $\frac{3}{4}$  cu. yd.

**Page 303.** — 23. Total, \$19.32; change, \$.68. 24. Total, \$3.78;  
change, \$1.22. 25. 288 cakes. 26. 46.98 lb.; 13.02 lb. 27. 12 lots;  
\$4200. 28. 85 $\frac{1}{2}$  ft. 29. \$160. 30. 16,380 lb. 31. 13 $\frac{1}{2}$  cu. yd.  
32. 40 A. 33. 5571 ft. 34. 3.1416 sq. rd.

**Page 304.** — 35. 83 $\frac{1}{2}$ %. 36. 176.4 sq. ft. 37. 4.075 A., or 4 A. 12  
sq. rd. 38. 5 $\frac{1}{3}$ %. 39. \$1200.40. 40. \$51.25. 41. \$376.10.  
42. \$81. 43. 1 $\frac{1}{2}$ %. 44. \$396. 45. 577.269 gal.

**Page 305.** — 46. \$3.924; \$5.855; \$6.841; 49.2%; 16.8%. 47. \$60.48.  
48. \$846.72. 49. 12%. 50. Shorter, 7 in., longer, 21 in.  
51. \$1905.75. 52. \$482.50.

# ANSWERS

xix

Page 306. — 53. Same. 54. \$4000. 55. 12,5664 ft. 56. \$3600.  
57. \$3500. 58. 648 A. 59. \$710. 60. \$28.80. 61.  $2\frac{1}{2}$  mi.  
62.  $27\frac{1}{11}\%$ . 63. \$6.75. 64. \$207.50.

Page 307. — 65. 35.7 %. 66. 32.5 %. 67. 41.7 %. 68. 41.2 %.  
69. 40.7 %. 70. 37.1 %. 71.  $33\frac{1}{2}\%$ . 72. \$990. 73. 6.5 %.  
74. \$651.42. 75. \$7000. 76. \$6000. 77. \$57. 78. 20 A.  
79. \$630.40.

Page 308. — 80. 962,000 men; 1,008,800 men; 109,200 men. 81. \$144.  
82. 60 shares. 83. \$151.59. 84. \$56,250. 85. \$525. 86. \$57.60.  
87. \$787.50. 88. 21 mi. 89. \$27.36.

Page 309. — 90. 4.4 %; 3.1 %. 91. 6283.2 sq. ft. 92. \$502.50.  
93. 1000 cu. ft. 94. \$887.50. 95. \$631.03. 96. 25 %; \$13.50.  
97. \$6. 98. \$2812.50.

Page 310. — 99. 918,951,600 bu. 100. 12.9 %. 101. 11,800,025 bales.  
102. 13 wk. 103. \$51,568. 104. \$50. 105. 15 mills. 106. 135,000  
gal. 107. \$137.77.

Page 311. — 108. 47 % inc.; 37 % inc.; .8 % dec.  
109. \$3,504,159,440.56. 110. 100 rd.; 200 rd. 111. \$43.70.  
112. \$3178.50. 113. Ninety-nine hundred thousandths. 114. 20 ft.  
115. 2 A.; 4 A.; 6 A. 116. 17.4 mills. 117. 1890 cu. ft.; 7110 cu. ft.

Page 312. — 118. 8.3 %. 119. 14.3 %. 120. 19.1 %. 121. 12.6 %.  
122. 14 %. 123. 18.2 %. 124. 15.4 %. 125. 11.1 %. 126. 21.4 %.  
127. 22.7 %. 128. 22.2 %. 129. 20.7 %. 130. 15.4 %. 131. 15.6 %.  
132. 14.3 %. 133. 14 %. 134. \$349.50. 135. \$94.50. 136. 30 %.  
137. \$1300.75. 138. \$2842.50.

Page 313. — 139. 20 % inc. 140. 23.8 % dec. 141. 39.4 % inc.  
142. 10.7 % dec. 143. 51 % inc. 144. 18.9 % inc. 145. 13.6 % inc.  
146. 13.6 % inc. 147. 21.2 % inc. 148. 12.5 % dec. 149. 11.8 % dec.  
150. 17.1 % inc. 151. 7.8 % inc. 152. \$144. 153. \$1032.82.  
154. \$.494. 155. \$2090.

Page 314. — 2. 21. 3. 18. 4. 12. 5. 4. 6. 14. 7. 22.

Page 315. — 3. 144. 4. 1260. 5. 480. 6. 1400. 7. 420.  
8. 96. 9. 630. 10. 576. 11. 720. 12. 255. 13. 5400. 14. 882.





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¶ By this method a spelling lesson of ten words is given each day from the spoken vocabulary of the pupil. Of these ten words two are selected for intensive study, and in the spelling book are made prominent in both position and type at the head of each day's lessons, these two words being followed by the remaining eight words in smaller type. Systematic review is provided throughout the book. Each of the ten prominent words taught intensively in a week is listed as a subordinate word in the next two weeks; included in a written spelling contest at the end of eight weeks; again in the annual contest at the end of the year; and again as a subordinate word in the following year's work;—used *five* times in all within two years.

¶ The Champion Spelling Book consists of a series of lessons arranged as above for six school years, from the third to the eighth, inclusive. It presents about 1,200 words each year, and teaches 312 of them with especial clearness and intensity. It also includes occasional supplementary exercises which serve as aids in teaching sounds, vowels, homonyms, rules of spelling, abbreviated forms, suffixes, prefixes, the use of hyphens, plurals, dictation work, and word building. The words have been selected from lists, supplied by grade teachers of Cleveland schools, of words ordinarily misspelled by the pupils of their respective grades.

AMERICAN BOOK COMPANY

# FORMAN'S ESSENTIALS IN CIVIL GOVERNMENT

By S. E. FORMAN, Ph.D.

Special Editions for New Jersey and Pennsylvania.

**T**HIS book for upper grammar grades and first years in the high school affords sound and systematic instruction in the fundamental principles of our government, and teaches the rights and duties of citizens. Its primary aim is to establish high political ideals, and to instill notions of civic morality—rather than to teach facts. Every lesson in civics is made a lesson in political ethics, and good citizenship is recognized to be an affair of the heart as well as of the head.

¶ The book begins with the government of the individual, of the family, and of the school, and later takes up in turn the county, town, township, city, State, and nation, describing each form of government in a simple, yet graphic manner. It contains an elaborate presentation of the workings of our national executive departments, and treats clearly the great topics of suffrage, elections, democracy, representation, checks and balances in governmental powers, local self-government, etc.

¶ It is written in plain, simple language on the topical plan, and is broad and pervaded with the spirit of true Americanism, without any sectionalism or localism. It is practical, bringing the pupil face to face with the affairs of the world around him. Personal responsibility in matters of government is emphasized wherever possible. Suggestive questions and exercises for review are plentifully supplied at the end of each chapter. The laboratory method of teaching is consistently applied throughout the book, which will make the boys and girls who study it better citizens.

AMERICAN BOOK COMPANY

# STAMPER'S TEXTBOOK ON THE TEACHING OF ARITHMETIC

By ALVA WALKER STAMPER, Ph. D., Head of the  
Department of Mathematics, State Normal School,  
Chico, Cal.

THE aim of this book is to give to teachers and prospective teachers a greater breadth of view in connection with the larger problems concerned with the teaching of arithmetic, some practical suggestions as to methods, and a brief but comprehensive review of subject matter.

¶ The book gives an interesting history of the subject; an account of the reasoning involved in arithmetic, in which are discussed the logical types and the application of induction and deduction to the various kinds of problems; a brief treatment of the scope and value of algebra and geometry in the elementary school; a general lesson plan, with ten plans worked out in detail; advice as to modes of instruction, etc.

¶ The work is carefully planned, the methods are up to date and practicable, and the subjects relate to actual life. The questions at the end of each chapter will stimulate thought and enlarge the teacher's view. They will also prove valuable to test the grasp of the subject held by prospective teachers in training schools using this book.

¶ The contents of the book include the following chapters: With Reference to the History of Arithmetic; The Reasoning Involved in Arithmetic; Preliminary Steps in Arithmetic; The Principal Operations in Arithmetic; The Application Side of Arithmetic—Percentage; The Application Side of Arithmetic—Forms and Measurements; Algebra and Geometry in the Elementary School; The Teacher's Preparation of the Lesson; In Relation to Schoolroom Practice; Supervised Teaching of Arithmetic in Teachers' Training Schools; In Relation to the Course of Study; and Books for Teachers.

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# TABLES FOR REFERENCE

## Liquid Measures

|               |                   |
|---------------|-------------------|
| 4 gills (gi.) | = 1 pint (pt.)    |
| 2 pints       | = 1 quart (qt.)   |
| 4 quarts      | = 1 gallon (gal.) |
| 31½ gallons   | = 1 barrel (bbl.) |

## Dry Measures

|               |                  |
|---------------|------------------|
| 2 pints (pt.) | = 1 quart (qt.)  |
| 8 quarts      | = 1 peck (pk.)   |
| 4 pecks       | = 1 bushel (bu.) |

The standard unit of liquid measure is the gallon. 1 gal. = 231 cu. in.; 1 cu. ft. = about 7½ gal. 1 gal. of water weighs about 8½ lb.; 1 cu. ft. of water weighs about 62½ lb., or 1000 oz.

The standard unit of dry measure is the bushel. 1 bu. (*stricken*, even full) = 2150.42 cu. in., or about 1½ cu. ft.

## Measures of Length

|                 |                  |
|-----------------|------------------|
| 12 inches (in.) | = 1 foot (ft.)   |
| 3 feet          | = 1 yard (yd.)   |
| 5½ yards        | } = 1 rod (rd.)  |
| 16½ feet        |                  |
| 320 rods        | } = 1 mile (mi.) |
| 5280 feet       |                  |
|                 | (statute)        |

## Measures of Surface

|                        |                 |
|------------------------|-----------------|
| 144 square(sq.) inches | = 1 square foot |
| 9 square feet          | = 1 square yard |
| 80½ square yards       | = 1 square rod  |
| 160 square rods        | } = 1 acre (A.) |
| 48,560 square feet     |                 |
| 640 acres              | = 1 square mile |

The standard unit of length is the yard.

1 nautical mile (knot) = 6080.27 ft. or nearly 1.15 common miles; 1 league = 3 nautical miles; 1 fathom = 6 ft.; 1 hand = 4 in.; 1 furlong = ¼ mi.

The acre is not a square unit like the square foot, the square yard, etc. When in the form of a square, it is nearly 209 ft. on a side.

## Surveyors' Measures

Surveyors and engineers formerly used the Gunter's chain. It is 66 ft. long and divided into 100 links of 7.92 in. each. They now generally use a steel tape 50 ft. to 100 ft. long divided into feet and tenths of a foot; or a chain 50 ft. to 100 ft. long having links each 1 foot in length, divided into tenths of a foot.

## Length

|             |                 |
|-------------|-----------------|
| 7.92 inches | = 1 link (li.)  |
| 100 links   | = 1 chain (ch.) |
| 80 chains   | = 1 mile (mi.)  |

## Surface

|                  |                  |
|------------------|------------------|
| 16 square rods   | = 1 square chain |
| 10 square chains | = 1 acre         |
| 640 acres        | = 1 square mile  |

## TABLES FOR REFERENCE

### Measures of Volume

|                         |                |
|-------------------------|----------------|
| 1728 cubic (cu.) inches | = 1 cubic foot |
| 27 cubic feet           | = 1 cubic yard |
| 128 cubic feet          | = 1 cord       |

1 cubic yard of earth is considered a load.

1 cord of wood = 128 cu. ft.

### Avoirdupois Weight

|                               |                             |                                                   |
|-------------------------------|-----------------------------|---------------------------------------------------|
| 16 ounces (oz.)               | = 1 pound (lb.)             | *60 pounds = 1 bu. of wheat<br>or of potatoes     |
| 100 pounds                    | = 1 hundredweight<br>(cwt.) | *56 pounds = 1 bu. of shelled<br>corn or of rye   |
| 2000 pounds                   | = 1 ton                     | *70 pounds = 1 bu. of corn in ear                 |
| 20 hundredweight = 1 ton (T.) |                             | *32 pounds = 1 bu. of oats                        |
| 2240 pounds = 1 long ton      |                             | *48 pounds = 1 bu. of buck-<br>wheat or of barley |
|                               |                             | 196 pounds = 1 bbl. of flour                      |
|                               |                             | 200 pounds = 1 bbl. of beef or<br>of pork         |

* In most states.

The standard unit is the **pound**, which = 7000 grains (gr.). 1 av. oz. = 437½ gr.

The long ton is used in the United States customhouses and in wholesale transactions in coal and iron. The long hundredweight = 112 lb.

### Troy Weight

|                 |                        |
|-----------------|------------------------|
| 24 grains (gr.) | = 1 pennyweight (pwt.) |
| 20 pennyweights | = 1 ounce (oz.)        |
| 12 ounces       | = 1 pound (lb.)        |
| 1 lb. = 12 oz.  | = 240 pwt. = 5760 gr.  |

1 Troy oz. = 480 gr.

The unit generally used for weighing diamonds, gems, etc., is the **carat**, which is about 3.2 Troy grains. It is used also to express the fineness of gold. 18 carats fine means  $\frac{18}{24}$  pure gold and  $\frac{6}{24}$  baser metal.

This textbook may be borrowed for two weeks, with the privilege of renewing it once. A fine of five cents a day is levied for failure to return a book on due.

**Apothecaries' Weight**

Used in filling medical prescriptions.

|            |                                      |
|------------|--------------------------------------|
| 20 grains  | = 1 scruple (sc. or $\mathfrak{S}$ ) |
| 3 scruples | = 1 dram (dr. or $\mathfrak{D}$ )    |
| 8 drams    | = 1 ounce (oz. or $\mathfrak{Z}$ )   |
| 12 ounces  | = 1 pound (lb. or $\mathfrak{L}$ )   |

**Apothecaries' Measure**

Used in filling medical prescriptions.

|                 |                                     |
|-----------------|-------------------------------------|
| 60 minims (m.)  | = 1 fluid dram (f $\mathfrak{z}$ )  |
| 8 fluid drams   | = 1 fluid ounce (f $\mathfrak{Z}$ ) |
| 16 fluid ounces | = 1 pint (O)                        |
| 8 pints         | = 1 gal. (Cong.)                    |

**Measures of Time**

|                   |                         |
|-------------------|-------------------------|
| 60 seconds (sec.) | = 1 minute (min.)       |
| 60 minutes        | = 1 hour (hr.)          |
| 24 hours          | = 1 day (da.)           |
| 7 days            | = 1 week (wk.)          |
| 12 months (mo.)   | } = 1 common year (yr.) |
| 365 days          |                         |
| 100 years         | = 1 century             |

Thirty days have September, April, June, and November.  
All the rest have thirty-one  
Save February, which alone  
Has twenty-eight, and one day  
more  
We add to it one year in four.

A solar year = 365 da. 5 hr. 48 min. 46 sec., or nearly 365 $\frac{1}{4}$  da. In business transactions 30 da. are usually considered as 1 mo. and 360 da. as 1 yr.

A leap year = 366 da. The centennial years divisible by 400, and all other years divisible by 4, are leap years. A decade = 10 yr.

**Angles and Arcs**

|                |                                                 |
|----------------|-------------------------------------------------|
| 60 seconds (") | = 1 minute (')                                  |
| 60 minutes     | = 1 degree (°)                                  |
| 360 degrees    | = 1 circumference                               |
| 1 right angle  | = 90°. $\pi$ = 3.1416 or about $\frac{22}{7}$ . |

**Counting**

|           |                  |
|-----------|------------------|
| 12 things | = 1 dozen (doz.) |
| 12 dozen  | = 1 gross (gro.) |
| 12 gross  | = 1 great gross  |
| 20 things | = 1 score        |

**United States Money**

|           |                  |
|-----------|------------------|
| 10 mills  | = 1 cent (¢)     |
| 10 cents  | = 1 dime         |
| 10 dimes  | } = 1 dollar (€) |
| 100 cents |                  |

***

**Stationers' Table**

|                                                                   |           |
|-------------------------------------------------------------------|-----------|
| 24 sheets                                                         | = 1 quire |
| 20 quires                                                         | = 1 ream  |
| Paper is also sold by the pound, and by 100, 500, and 1000 sheets |           |

**Foreign Money**

|                        |             |
|------------------------|-------------|
| £ 1 (British money)    | = \$ 4.8665 |
| 1 franc (French money) | = \$ .193   |
| 1 lira (Italian money) | = \$ .193   |
| 1 mark (German money)  | = \$ .238   |

